DOCUMENT RESUME

ED 042 360 EM 008 364

AUTHOR	Gallagher, Paul D.
TITLE	An Investigation of Instructional Treatments and Learner Characteristics in a Computer-Managed Instruction Course. Tech Report Number 12.
INSTITUTION	Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
SPONS AGENCY	Office of Naval Research, Washington, D.C. Personnel and Training Branch.
PUB DATE	30 Jul 70
NOTE	112p.
EDRS PRICE	EDRS Price MF-$0.50 HC-$5.70
DESCRIPTORS	Computer Assisted Instruction, Computer Oriented Programs, Evaluation, *Individual Instruction, Instructional Materials, Interaction, *Learning Characteristics, Literature Reviews, Programed Instruction, Programed Texts, Sequential Approach, *Student Developed Materials, Systems Approach

ABSTRACT

The intent of this investigation was to answer a number of questions in regard to instructional treatments and learner characteristics in a Computer-Managed Instruction (CMI) learning environment. Treatments varied in terms of sequence of tasks and evaluation of instructional materials. Sequencing was either student-selected or computer-assigned while evaluation was conducted by an instructor or by means of a student-computer interaction. Analyses were conducted to identify specific student attitudes, personality characteristics, and background information related to course success. There were no differences among the four instructional treatments on any of the four dependent measures: midterm score, final product score, time to complete the course, and system time. Further analysis indicated that there was a relationship between specific learner characteristics and course success. The students who proved most successful in the course indicated that they liked to be active in the learning situation, admitted to few feelings of anxiety, and expressed positive attitudes toward CMI. A relationship also was found between on-task anxiety state and performance on task quizzes. This investigation is thought to have laid the groundwork for future research in the area of CMI. (Author/MF)

ED0 42360

CAI CENTER

TECH REPORT

AN INVESTIGATION OF INSTRUCTIONAL TREATMENTS AND LEARNER CHARACTERISTICS IN A COMPUTER-MANAGED INSTRUCTION COURSE

Paul D. Gallagher

Tech Report No. 12
July 30, 1970

Project NR 154-280
Sponsored by
Personnel & Training Research Programs
Psychological Sciences Division
Office of Naval Research
Washington, D.C.
Contract No. N00014-68-A-0494

This document has been approved for public release and sale; its distribution is unlimited.

Reproduction in Whole or in Part is Permitted for any Purpose of the United States Government.

FLORIDA STATE UNIVERSITY

EM 008 364

ED0 42360

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. *ORIGINATING ACTIVITY (Corporate author)* Florida State University Computer-Assisted Instruction Center Tallahassee, Florida 32306	2a. *REPORT SECURITY CLASSIFICATION* Unclassified 2b. *GROUP*

3. *REPORT TITLE*

An Investigation of Instructional Treatments and Learner Characteristics in a Computer-Managed Instruction Course

4. *DESCRIPTIVE NOTES (Type of report and inclusive dates)*

Tech Report No. 12, July 30, 1970

5. *AUTHOR(S) (First name, middle initial, last name)*

Paul D. Gallagher

6. *REPORT DATE* July 30, 1970	7a. *TOTAL NO. OF PAGES* 94	7b. *NO. OF REFS* 56

8a. *CONTRACT OR GRANT NO.* N00014-68-A-0494	9a. *ORIGINATOR'S REPORT NUMBER(S)*
b. *PROJECT NO.* NR 154-280	9b. *OTHER REPORT NO(S) (Any other numbers that may be assigned this report)*
c.	
d.	

10. *DISTRIBUTION STATEMENT*

This document has been approved for public release and sale; its distribution is unlimited.

11. *SUPPLEMENTARY NOTES*	12. *SPONSORING MILITARY ACTIVITY* Personnel & Training Research & Program Office of Naval Research Washington, D.C.

13. *ABSTRACT*

The primary objectives of this investigation were to answer a number of important questions in regard to instructional treatments and learner characteristics in a Computer-Managed Instruction learning environment. An evaluation was conducted in order to ascertain which of four instructional treatments produced the most efficient and effective learning. The treatments varied in terms of sequence of tasks and type of evaluation of instructional materials developed by the students in the course. Sequencing was either student selected or computer assigned while evaluation was conducted by an instructor or by means of a student-computer interaction. Analyses were conducted in order to identify and isolate specific student attitudes, personality characteristic, and background information which were related to course success.

DD FORM 1473 (PAGE 1)
1 NOV 65
S/N 0101-807-6811

Security Classification

A-31408

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

DD FORM 1 NOV 65 1473 (BACK)

S/N 0101-807-6821

Security Classification

ABSTRACT - continued

There were no differences among the four instructional treatments on any of the four dependent measures: (1) midterm score, (2) final product score, (3) time to complete the course, and (4) system time. Further analysis indicated that there was a relationship between specific learner characteristics and course success. The students who proved most successful in the course indicated that they liked to be active in the learning situation, admitted to few feelings of anxiety, and expressed positive attitudes toward CMI. Furthermore, a relationship between on-task anxiety state and performance on task quizzes was found.

In summary, the findings of this study have answered a number of the important questions with regard to instructional treatments and individual learner characteristics in a Computer-Managed Instruction course. This investigation has also laid the groundwork for future research in the relatively new area of CMI.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

AN INVESTIGATION OF INSTRUCTIONAL TREATMENTS AND LEARNER CHARACTERISTICS IN A COMPUTER-MANAGED INSTRUCTION COURSE

Paul D. Gallagher

Tech Report No. 12
July 30, 1970

Project NR 154-280
Sponsored by
Personnel & Training Research Programs
Psychological Sciences Division
Office of Naval Research
Washington, D.C.
Contract No. N00014-68-A-0494

This document has been approved for public release and sale; its distribution is unlimited.

Reproduction in Whole or in Part is Permitted for any Purpose of the United States Government.

ABSTRACT

AN INVESTIGATION OF INSTRUCTIONAL TREATMENTS AND LEARNER CHARACTERISTICS IN A COMPUTER-MANAGED INSTRUCTION COURSE

Paul D. Gallagher
The Florida State University, 1970

The primary objectives of this investigation were to answer a number of important questions in regard to instructional treatments and learner characteristics in a Computer-Managed Instruction learning environment. An evaluation was conducted in order to ascertain which of four instructional treatments produced the most efficient and effective learning. The treatments varied in terms of sequence of tasks and type of evaluation of instructional materials developed by the students in the course. Sequencing was either student selected or computer assigned while evaluation was conducted by an instructor or by means of a student-computer interaction. Analyses were conducted in order to identify and isolate specific student attitudes, personality characteristic, and background information which was related to course success.

There were no differences among the four instructional treatments on any of the four dependent measures: (1) midterm score, (2) final product score, (3) time to complete the course, and (4) system time. Further analysis indicated that there was a relationship between specific

learner characteristics and course success. The students who proved most successful in the course indicated that they liked to be active in the learning situation, admitted to few feelings of anxiety, and expressed positive attitudes toward CMI. Furthermore, a relationship between on-task anxiety state and performance on task quizzes was found.

In summary, the findings of this study have answered a number of the important questions with regard to instructional treatments and individual learner characteristics in a Computer-Managed Instruction course. This investigation has also laid the groundwork for future research in the relatively new area of CMI.

ACKNOWLEDGMENTS

I am extremely grateful to Dr. Walter Dick who guided me through my graduate career and this dissertation. I thank him for his teachings, his patience, and his confidence in me. I am also deeply indebted to Dr. Duncan Hansen. He demonstrated a commitment which aided in the successful completion of my graduate training at Florida State. I also acknowledge the advice and assistance of my committee members.

I am indebted to the entire CAI Center staff for their understanding, friendship, and assistance. Without them, it would have been impossible to survive the madness.

A very special thanks goes to my friend and colleague, Dr. Harold O'Neil. His excellent assistance and editorial work has been extremely helpful.

Finally, I thank and dedicate this dissertation to Betty, Becky, and Bryan. In a very special way, they have helped in making me what I am today.

TABLE OF CONTENTS

Page

ABSTRACT ii
ACKNOWLEDGEMENTS iv
LIST OF TABLES vii
LIST OF FIGURES viii

Chapter

I. INTRODUCTION 1
    Statement of the Problem
    Investigatory Questions

II. REVIEW OF LITERATURE 6
    Individualized Instruction
    Computer-Assisted Instruction (CAI)
    Computer-Managed Instruction
    Sequencing of Instruction and Evaluation of Learning Outcomes
    Learner Characteristics
    Summary

III. METHODS AND PROCEDURES 19
    Description of the CMI Course
    Course Development
    Implementation of the Graduate Course
    Evaluation Instruments
    Subjects
    Apparatus
    Experimental Design
    Experimental Procedures

IV. RESULTS 35
    Relationship of Learner Characteristics to Performance
    Cost of CMI Presentation

V. DISCUSSION 49
    Instructional Treatment Comparisons
    Performance
    Relationship of Learner Characteristics to Performance
    Relationship of A-State to Task Performance

Table of contents - continued

Chapter Page

VI. SUMMARY 56

REFERENCES 60

APPENDICES

APPENDIX A 65
APPENDIX B 68
APPENDIX C 70
APPENDIX D 71
APPENDIX E 72
APPENDIX F 73
APPENDIX G 76
APPENDIX H 77
APPENDIX I 78
APPENDIX J 79
APPENDIX K 81
APPENDIX L 85
APPENDIX M 90
APPENDIX N 91
APPENDIX O 92

VITA 93

LIST OF TABLES

TABLE | Page
1. Means and standard deviations of four instructional treatments for midterm examination scores 36
2. Analysis of variance: four instructional treatments on midterm examination scores 36
3. Means and standard deviations of four instructional treatments for final product score 37
4. Analysis of variance: four instructional treatments on final product score 37
5. Means and standard deviations of four instructional treatments for total time spent at the terminal (system time) 38
6. Analysis of variance of four instructional treatments on total terminal time (system time) 38
7. Means and standard deviations of four instructional treatments for time (days) to complete tasks 1-13 39
8. Analysis of variance of four instructional treatments on time (days) to complete tasks 1-13 40
9. Stepwise multiple regression variance estimates: Midterm exam score for total group 41
10. Stepwise multiple regression variance estimates: Time (days) to complete tasks 1-13 for total group 42
11. Stepwise multiple regression variance estimates: Final product score for total group 43
12. Stepwise multiple regression variance estimates: Final product score for instructor evaluated group 43
13. Stepwise multiple regression variance estimates: Final product score for computer evaluated group 44
14. Analysis of anxiety questionnaire 45
15. Correlation of A-State amxiety and quiz performance on tasks 1-13 46
16. Cost analysis of course presentation 48

LIST OF FIGURES

FIGURE Page

1. Task analysis of techniques of programmed instruction 21
2. Logic flow for student proceeding through the CMI system 24
3. Experimental design with number of students 31

CHAPTER I

INTRODUCTION

One of the most controversial issues in education today is concerned with the extent to which technology, particularly the computer, is to be used in the classrooms of the future. Advocates of the utilization of the computer have been excited by the many prospects of a completely individualized learning situation controlled by the high speed, reliable computer. In fact, the main case for computerized instruction hinges primarily on the argument that the computer is capable of responding to most, if not all, of the individual differences of students (Suppes, 1967). With its immense storage capacity, the computer could be programmed to tailor instruction to the needs of every student.

The educational use of the computer has spread to both the university and public schools (Atkinson & Wilson, 1969). Since its beginning in the late fifties, the number of educational facilities that have either purchased computers and terminals or have leased time from time-sharing systems has increased one hundred fold. A cursory survey of nine of the major educational systems who use Computer-Assisted Instruction in the United States reveals that over twenty thousand students will have experience with CAI during the 1969-1970 school year (Dick, Latta, & Rivers, 1970). Students will have the opportunity to learn via the computer in such areas as reading, math, science, spelling, physics, etc. The immediate impact of these systems using CAI can be seen in the reported results of Suppes (1968) and Hansen, Dick, & Lippert (1968). These, plus other promising results, demonstrate that using the computer to aid instruction possesses a great potential in individualizing instruction.

Although CAI provides an individualized learning setting, the costs are still prohibitive for the average school (Mitzel, 1967). Therefore, if the computer is to be used in education, a cost reduction will have to come about. One long-range possibility for this is the reduction of computer costs due to technological advancements. However, a more immediate solution to the problem is the utilization of computers in a more economical fashion. One such technique, called Computer-Managed Instruction, attempts to maximize the computer's ability in diagnosing and prescribing in an individualized instruction setting. The computer becomes the manager instead of the disseminator of instruction as in CAI. The role of the computer is one of evaluating the student's step-by-step progress and recommending remedial or enrichment materials where appropriate. The computer acts as a managerial decision-maker, providing information to both the student and the instructor whenever it is needed. Investigations of the feasibility of CMI at Systems Development Corporation (Coulson, 1967), New York Institute of Technology (Schure, 1967), and the American Institute for Research (Flanagan, 1968), have offered encouraging results in terms of the potential use of the computer as a manager of instruction. However, as with most of the research within CAI, the applied aspects have been mainly considered while the much-needed basic research has been neglected. Little has been done to solve problems such as the identification of specific learner characteristics which may be relevant to success in courses controlled by the computer or the determination of an optimum instructional treatment. A study by Majer (1969) attempted to isolate important learner characteristics that could be used in a freshman physics course taught via CAI. Unlike most investigations of this kind, Majer considered a broad scope of individual difference variables and their relationship to success in the computerized course of instruction. Other than this study, which dealt with CAI, little data have been reported as to the importance of various instructional treatments or relevant learner characteristics in computerized instruction. This is particularly true in the area of CMI.

Statement of the Problem

It is apparent from the preceding that there are a number of questions with regard to instructional treatments and individual learner characteristics in a Computer-Managed Instruction learning environment. These questions will be raised by administrators, teachers, and even students, and their answers should be forthcoming if CMI is to play a major role in individualizing instruction. Therefore, the purpose of this study was to consider some of these questions. Specifically, this investigation attempted to determine (1) if one of four instructional treatments in a CMI course would prove to be most effective and efficient in terms of student performance and cost, and (2) whether specific learner characteristics which were related to course success could be identified in order to be able to make predictive inferences about future students. The treatments, which included the variation of sequence of learning tasks and the type of evaluation of the student's report on a course product, ranged from a highly structured one of Computer-Assigned Sequence/Computer Evaluated Project to the least structured-Student Selected Sequence/Instructor Evaluated Product. The learner characteristics which were investigated included various personality, attitude and background measures.

Investigatory Questions

The following are the specific questions which this investigation of CMI attempted to answer:

1. Under which of four instructional treatments would students perform best?
2. Which treatment would be most efficient from a cost-benefit point of view?
3. To what extent were individual learner characteristics important in a CMI learning environment?
4. Given that there are learner differences, were all characteristics equally relevant?
5. Would the specific learner characteristic information allow for predictive inferences about the success of particular types of individuals?

This investigation critically examined these questions by focusing on two major areas. First, there was an experimental comparison of performance on a midterm examination, a final course document, and the time required to complete the course for four experimental groups in the course--Techniques of Programmed Instruction--presented via CMI techniques. Secondly, an evaluation was made to ascertain the relationship among various learner characteristics on the dependent measures mentioned. In addition, a cost analysis of the presentation of the course was conducted.

In summary, this investigation evaluated the outcomes of a course presented via Computer-Managed Instruction. The primary objectives were to (1) identify an optimum instructional treatment, and (2) identify learner characteristics related to success in the course.

CHAPTER II

REVIEW OF LITERATURE

The primary objectives of this study were to investigate several instructional treatments and various learner characteristics in a completely individualized computer-managed instruction course. In order to provide the background on the relationships between individualizing instruction, computer technology, and optimal learner-treatment conditions, this review of the literature will cover five areas relevant to the study: (1) individualized instruction; (2) computer-assisted instruction; (3) computer-managed instruction; (4) sequencing of instruction and computer evaluation of learning outcomes; and (5) learner characteristics and trait treatment interactions.

Individualized Instruction

Although the definition of individualized instruction varies, it is generally used to describe a learning environment in which an attempt is made to plan and construct an instructional setting tailored to the individual learner's needs and characteristics, e.g., personality attitudes, intelligence, aptitudes, etc. The major purpose is to maximize student learning by the adaptation of instruction in accordance with these individual differences.

Mager and Clark (1963) used industrial trainees to compare individual and conventional instructional methods. Mager's procedure was to provide the individualized group with explicitly written behavioral objectives pertaining to the materials. The self-directed or individualized group was also provided with a list of references and names of key personnel to use if and when necessary. The reported results indicated that not only did the individualized group score significantly higher on the criterion test, but they completed the course in less time. Also, in a post instructional interview, the self-directed group expressed a more positive attitude toward the instruction than did the conventionally taught group.

The previously reported study offers important evidence of the potential of individualized instruction. However, convincing data is not yet available from such large scale projects located in: (1) the Duluth, Minnesota School System (Esbensen, 1968), (2) the Oakleaf School System in Pittsburgh, Pennsylvania (Glaser, 1968; Bolvin & Linvall, 1968), and (3) Project PLAN in Palo Alto, California (Flanagan, 1968). It is the purpose of these projects to individualize a portion of the school day to allow the students an opportunity for maximum learning. However, thus far, only the Duluth Project has reported any positive results--these have been promising but not startling (Esbensen, 1968). Glaser (1968) reports that the Oakleaf Project, now in its third year, is finally moving toward a position where comparisons can be made. Flanagan (1968), like the others, has reported promising implications, but as yet has no data to substantiate the potential of individualized instruction. Thus, it is apparent that it will be some time before data will be available upon which to determine the impact of individualized instruction on a school system.

Although all of the above studies have considered individualizing instruction as their main concern, it is important to stop and consider exactly what is being individualized. In summarizing the research on individualized instruction it is apparent that these investigations are not considering learner characteristics or instructional treatments that may be important if individualized instruction is to have an effect. The major individual difference variable that these investigations have considered has been the rate at which thestudent proceeds through the program. They have mainly looked at how rapidly a student can complete a learning sequence if he is given resources and the freedom to work as an individual controlling his own learning rate. This appears to be only the first step toward complete individualized instruction in which learner characteristics play an important role in aiding in the diagnosis and prescription of instruction. Without the use of technology such as the computer, it is extremely difficult to obtain and record the immense data that would aid in maximizing the learning situation. Thus, one viable use of the computer in individualized instruction is the presentation of the instruction and the continuous gathering and monitoring of student data.

Computer-Assisted Instruction (CAI). A great number of claims have been made about CAI in relationship to the individualization of the instructional program on the basis of the student's past performance and related learner characteristic information. The reports of Hansen (1968) and Hansen & Dick (1968) lend support to the concept that by individualizing instruction via CAI more effective learning will take place. Utilizing a freshman physics course adapted for CAI, these investigations indicated that the CAI group scored higher on a posttest than did a control group taking the same course via traditional lecture methods.

Proctor (1967) has also reported success of individualizing instruction through the use of CAI. This study compared a group of students taking a course on curriculum development via CAI with a group taking the identical course via traditional lecture. Results favored the CAI group on both a posttest and a retention test. Similar results were reported by Schurdak (1967) who investigated the effects of a CAI program, a programmed text, and a conventional textbook-workbook combination, in teaching Fortran programming to college students. The CAI group scored significantly higher on a posttest than did the other two groups and also completed the course in less time.

Schwartz and Long (1967) compared a self-study program on computers with CAI. For a sample of forty IBM field engineers (Control = 16, CAI = 24), they found no differences on a posttest; however, the CAI group took significantly less time to complete the course. In a similar study, Schwartz & Haskell (1966) used a CAI program in training electronics technicians in basic data processing and found similar results.

Suppes (1968) has also shown the success of CAI in individualizing instruction in the areas of arithmetic and reading at the elementary school level. The reading results have shown statistically significant gains for CAI groups in all areas except comprehension when compared to control groups.

As with most of the other literature on individualized instruction these investigations have mainly considered the rate at which the student proceeds through the instruction. Significant time savings have been found in almost every study. However, some attention should be directed toward the learner characteristics that may be useful with computerized instruction. Of all of the CAI investigations only two major ones have gone beyond only looking at one or two learner characteristics. Davis, Denny, & Marzocco (1967) have reviewed theoretical and empirical research on individual differences and have reported research on the interactions of these differences and method variables for a CAI and PI course on remedial mathematics at the college level. They concluded that learner characteristics such as ability, attitude, and interests had no relationship to the treatments and were of no value in prescribing an optimum instructional treatment. However, in contrast to these results, Majer (1969) found that in his study, there was an interaction of individual characteristics and instructional mode. The results of this study indicated that there are certain personality characteristics which are related to performance in a course taught by CAI as compared to a traditional lecture group. From results such as these, it can be proposed that in computerized instruction there may be certain characteristics that the student brings to the situation which are related to his success in that learning situation as compared to a lecture class. Therefore, if it can be shown that a relationship exists between learner characteristics and individualized instruction via CAI, it would be appropriate to suggest that these same characteristics would affect student performance in a course taught using Computer-Managed Instruction techniques. However, because CMI is relatively new in education, the only studies that have been reported deal with the feasibility of the method. These studies place their major emphasis on the diagnosis and prescription of instruction using only achievement data.

Computer-Managed Instruction. Although, to date, no major CMI effort has placed an emphasis on learner characteristics or instructional treatments, it is important to review the literature on the feasibility of CMI.

One instructional management system, called IMS, developed by System Development Company (SDC) and the Southwest Regional Laboratory (SWRL), is operating in various Los Angeles City Schools (Kooi & Coulson, 1967; Coulson, 1967; Silberman, 1968; & Kooi, 1968). This system evaluates students with criterion referenced tests taken on answer sheets which are scored by an on-line optical scanner located at SDC. These data are analyzed by a series of programs that associate student response data with instructional objectives and designate appropriate prescriptive information, record individual and group performance, and generate a printout for the teacher. This printout describes who is having learning difficulties, suggests alternative activities, and refers the teacher to supplementary instructional materials that are on store in his file. The teacher may obtain any desired data through the use of a teletype terminal located in the school which is connected to the centrally located computer.

Another management system called PLAN (Program for Learning in Accordance with Needs) is being developed by the American Institutes for Research (AIR), the Westinghouse Learning Corporation, and fourteen cooperating school systems (Flanagan, 1968, 1967). Similar to that of SDC, this system collects criterion-referenced test data which facilitate the making of educational decisions. The PLAN system is currently being used in the 14 schools in grades one, two, three, five, six, seven, nine, ten, and eleven, and services approximately 9000 students (Rahmbow, 1969).

Another project using CMI has been undertaken by the New York Institute of Technology (Schure, 1967; O'Dierno, 1968). Assessment data are being collected in the areas of mathematics, physics, electronic technology, and computer science. This system has operated without student-terminal interaction. All data have been input to the computer via punched cards. To date, no results have been reported.

All of these CMI systems have the potential as branching individualized programs of study and information flow to help the teacher to monitor, test, evaluate, and direct student progress (Brudner, 1969). Each student should receive a variety of instructional materials suited to his individual learner characteristics. However, from an analysis of the major CMI projects, it is apparent that the present projects have not seriously utilized learner characteristic data in maximizing the instructional system via prescriptions based on that data. It remains for a study such as that conducted here to consider the implications of learner and instructional treatment differences and their relationships to success in an operating CMI system.

The final portion of this review will include descriptions of specific results on learner characteristics and instructional treatments which are related to learning and may play an important role in determining the success of students operating in a CMI learning environment.

Sequencing of Instruction and Evaluation of Learning Outcomes. The concept of sequencing of instruction has mainly been investigated in the area of programmed instruction in studies such as those of Roe, Case, and Roe (1962), Levin & Baker (1962), & Roe (1962). These studies report conflicting evidence as to whether an ordered or scrambled sequence of instructional frames produces the best results. However, Evans (1965) states that "on an a priori basis, it seems highly unlikely that any topic of complexity can be taught through programming or through any other method in any sequence other than an orderly one." However, it is possible that with very short programs, scrambling of the order may make little difference.

Using a course on curriculum development as the basis for a CAI investigation, Proctor (1968) found that the self-selection of a variety of sequences did not significantly affect learning acquisition. He did however report that the majority of the group were apparently guided to varying degrees in their selections by the author-determined sequence. In a similar study, Thomas (1970) attempted to determine the effects of learner-control and prior knowledge on learning mathematical learning models under CAI. The reported results revealed that, for the No Prior Knowledge group, higher posttest scores were found for the learner-control condition than for the author-control condition. However, no differences were found between the learner-control and author-control conditions for the Prior Knowledge group. Thomas (1970) concluded that the inability to detect a difference in this latter group may be due to his sample size and the insensitivity of the posttest.

No studies involving the concept of computer-facilitated evaluation of learning outcomes could be found. Suppes (1967) does discuss the use of the computer in an interactive dialogue mode. He states that a major potential use of the computer is the possibility of establishing a Socratic learning environment in which the computer and student would react to each other's responses. However, to date, educational research with the computer has not advanced to this stage.

In summary, the effects of sequencing of instruction and evaluation via the computer are relatively unexplored. With the exception of the Proctor (1968) and Thomas (1970) studies using CAI, little has been done in either of these two areas.

Learner Characteristics. Thus far, this review has established the relative effectiveness and potential of individualizing instruction through the use of the computer. The question which now arises is, "How does one assign students to alternative instructional treatments in a manner that maximizes the learning payoff?" (Ripple, Millman, & Glock, 1969, P. 113). Many current practices and research projects are operating under the assumption and expectation that students should be provided with the mode of instruction best suited to their cognitive styles, interests, personality characteristics, etc. (Flanagan, 1967). Briggs (1968) has stated that while no one learning variable (or characteristic of the learning program) can yet be said to outweigh all others in importance, certain issues seem worthy of exploration when searching for key characteristics of media and materials which may eventually bring about effective individual or group instruction; sensory mode; IQ; special aptitudes; entering competencies; sequencing of instruction; and programming variables. The object of this portion of the review is to discuss the relationship between instructional mode and learner characteristics.

Using a programmed instruction unit, Doty & Doty (1964) have shown that achievement appears to be related to a series of personality characteristics. Their results indicate that the students who learned best using the materials had low social needs and scored low on various creativity measures. There was no correlation between achievement needs and performance; however, there was a high positive correlation between grade point average and attitude toward the instructional mode.

Another investigation of the effects of personality characteristics was that of Woodruff, Faultz, & Wagner (1966). They reported significant correlations of achievement motivation ($r = .53$), cautiousness - impulsivity ($r= .50$), original thinking ($r = .74$), and personal relations ($r = .81$) with performance on a programmed text. They used the Edwards Personal Preference Schedule (EPPS) and the Gordon Personal Inventory to obtain their measures. Also using the EPPS, Lubin (1965) reported that low autonomy students do better than high autonomy students in an individualized setting using programmed instruction. Kight & Sassenrath (1966) have reported that high-achievement motivated students performed better in a PI setting on time to complete the course, number of errors, and short-term retention than did a group of studentss with low achievement motivation.

In considering anxiety as a learner characteristic, previous research on the effects of this characteristic suggests that high anxious students will make more errors than low anxious students on difficult materials, while high anxious students will do as well as low anxious students on easy materials (O'Neil, Spielberger, & Hansen, 1969); Grimes & Allinsmith, 1961). The recent findings of Ripple, Millman & Glock

(1969) were consistent with the host of previous studies on the relationship between anxiety and achievement.

In considering other learner characteristics, Levin & Baldwin, (1959) and Levin, Baldwin, Gallwey, & Paivio (1960) reported that learners scoring low on tests of exhibitionism do relatively better on an individualized PI course than do those scoring high on the scale. Exhibitionism is exemplified by the degree of an individual's positive attitude toward showing himself and his products to an audience and the tendency to approach situations involving performance.

Considering another individual difference, Grimes and Allinsmith (1961) found similar results for compulsivity regarding achievement in structured and unstructured learning situations, as they did for anxiety. Learners scoring high on tests of compulsivity did relatively better in PI learning tasks.

In investigating trait-treatment interactions, Snow (1969) has reported interactions of ability and program method which lead to the conclusion that the phonic method appears more appropriate for low ability students, while higher ability students seem to learn better with the look-say method. Kropp, Nelson, & King (1967) found aptitude treatment interactions in subject matter areas such as mathematics, vocabulary, reading and chemistry. They conclude that it is reasonable to state that achievement of students can be enhanced by assigning them to instructional materials known to be optimally related to ability patterns. Mitzel (1967) and Silberman et al. (1960) have reported similar results for the relationship between aptitude and achievement.

Stolurow & Davis (1965) reviewed a series of studies on the interaction of individual difference variables with method of instruction and concluded that such interactions did, in fact, occur in a variety of instructional settings and methods. They also concluded that the computer will play an important role in identifying these differences and their implications for maximizing the instructional setting.

One of the few studies that have been concerned with a series of learner characteristics and their relationships to learning in a CAI setting has been that of Majer (1969). He concluded that certain attitude, personality, and background characteristics differentially predict performance. He also concluded that course structures and procedures may be more effectively designed to provide an optimal learning environment for the individual student. On the masculinity-femininity scale of the OPI which assesses some of the differences in attitudes between college men and women, there was a negative relationship between course performance and the scale score. This result indicates that successful CAI students tend to be stronger in esthetic and social inclinations and admit to greater sensitivity and emotionality. Also, a negative correlation between the OPI Estheticism scale and performance suggests that successful CAI students do not have diverse interests in artistic matters and activities. Finally, the successful CAI students had a positive test taking attitude (OPI Response Bias) and were people who had concern about social injustices and institutional wrongdoing. In contrast, the characteristics of students who were successful in the traditional lecture group were markedly different from those of the CAI group. In this group there was a strong positive relationship between course performance and scores on the OPI Masculinity-Femininity scale. A negative correlation with the OPI Impulse Expression scale indicates that these people were not prone to engage in fantasies or seek immediate gratification. Also, success in this group was found to be negatively related to practical outlook. It is from the implications of this study that a groundwork for the proposed investigation is laid.

Summary. This review has presented studies in the areas of individualized instruction, CAI, CMI, sequencing and evaluation, and learner characteristics. The tentative results of the investigations of individualized instruction, CAI, and CMI suggest the potential of educational technology for having an important impact on educational systems of the future. In addition, the results reported on the sequencing of instruction, evaluation of learning outcomes, and learner characteristics have important implications for promoting efficient and effective learning. It is the interaction and synthesis of these investigations that reveal the apparent need for an investigation of various instructional treatments and the relationship of learner characteristics to success in a CMI course.

CHAPTER III

METHODS AND PROCEDURES

This study was undertaken to determine if one of four instructional treatments in a CMI learning environment would produce significantly better results in terms of student performance and whether specific learner characteristics which were related to course success could be identified in order that it might be possible to make predictive inferences about future students. Graduate students who enrolled for a graduate course in the College of Education at Florida State University - EDR 537 - Techniques of Programmed Instruction during the fall of 1969, participated in the study. The course consisted of twenty tasks. The instructional treatments varied in terms of the sequence of tasks and the type of evaluation of a student's term project. The battery of learner characteristics selected was considered relevant and appropriate to an individualized learning environment such as the CMI course. The principal dependant variables were a midterm examination score, final project score, and the total time spent at the terminal.

Description of the CMI Course

The course of instruction used in this study was Educational Research 536--Techniques of Programmed Instruction, which was adapted for Computer-Managed Instruction. Until this investigation, the course had been taught via conventional lecture techniques. The major objective of the course is to provide the student with a working knowledge of both the cognitive and productive aspects of the use of the Systems Approach in the design of instructional materials, particularly programmed instruction. The cognitive aspects can be thought of in terms of specific content that is to be mastered. The productive aspects of the course can best be considered as being similar to a course project.

The student is evaluated by two methods. First, he is administered a short-answer recall exam on the cognitive aspects of the course. Secondly, he is evaluated on a documented report on his own utilization of the Systems Approach in the design, implementation, and evalution of a programmed sequence in a topic area he has selected. The development and evaluation of a one-half to one hour long programmed instruction text using systems approach techniques is considered the primary task for the students in the course. A description of the development and implementation of the course follows.

Course Development. In adapting the EDR 537 course for CMI, the initial step was to analyze the content area using the professor's prior notes and taped lectures as a basis. Twenty specific tasks as shown in Figure 1, were identified as comprising the course. These tasks were, in turn, categorized as cognitive and/or productive as follows:

A. Cognitive - On this type of task, the student has to demonstrate competency by achieving eighty percent correct responses on a criterion-referenced true-false or multiple-choice test at the CMI terminal. For example, the student is required to correctly answer four of five questions which are randomly selected

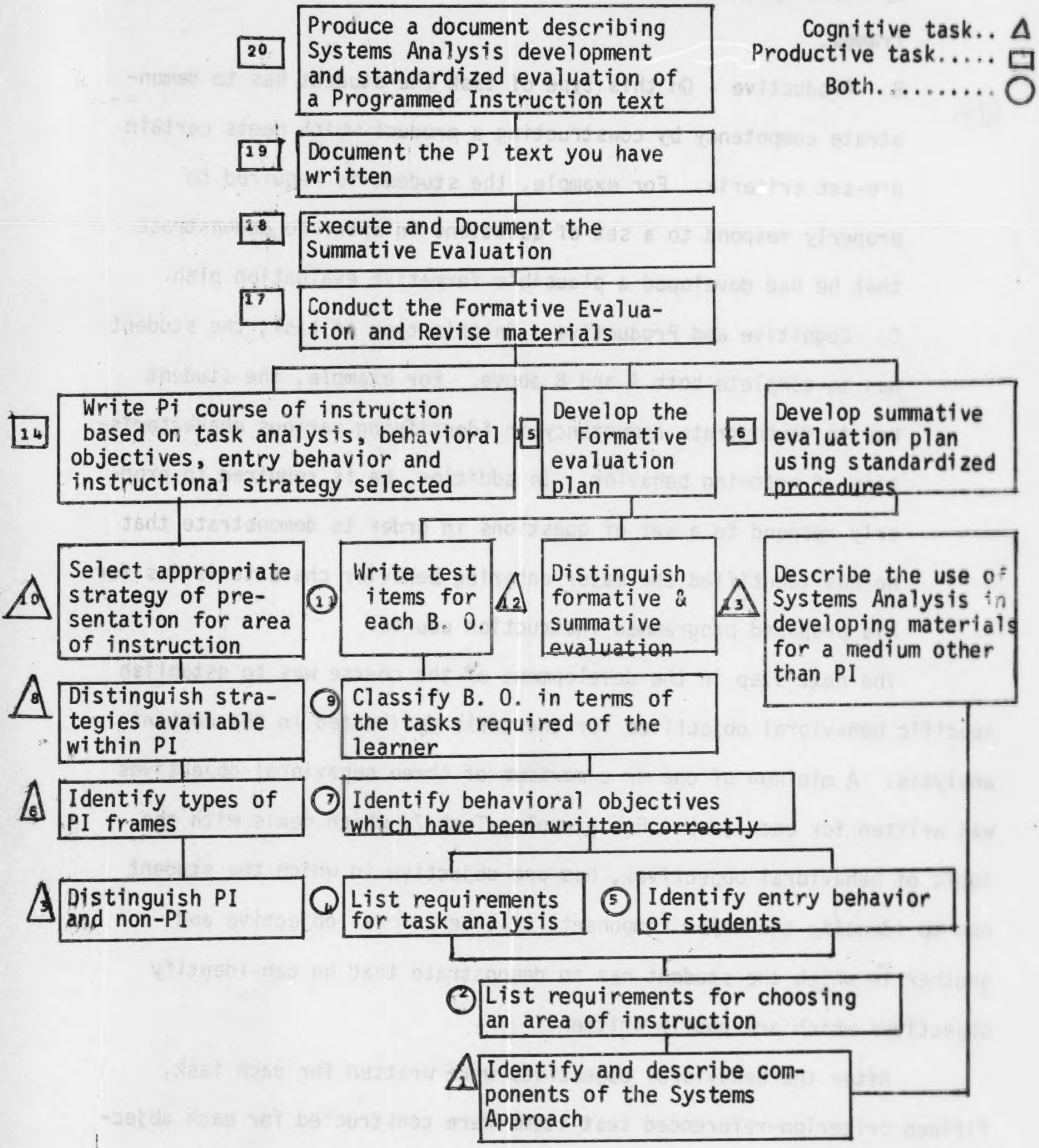
Cognitive task.. △
Productive task..... □
Both........ ○
20 Produce a document describing Systems Analysis development and standardized evaluation of a Programmed Instruction text
19 Document the PI text you have written
18 Execute and Document the Summative Evaluation
17 Conduct the Formative Evaluation and Revise materials
14 Write Pi course of instruction based on task analysis, behavioral objectives, entry behavior and instructional strategy selected
15 Develop the Formative evaluation plan
16 Develop summative evaluation plan using standardized procedures
10 Select appropriate strategy of presentation for area of instruction
11 Write test items for each B. O.
12 Distinguish formative & summative evaluation
13 Describe the use of Systems Analysis in developing materials for a medium other than PI
8 Distinguish strategies available within PI
9 Classify B. O. in terms of the tasks required of the learner
6 Identify types of PI frames
7 Identify behavioral objectives which have been written correctly
3 Distinguish PI and non-PI
4 List requirements for task analysis
5 Identify entry behavior of students
2 List requirements for choosing an area of instruction
1 Identify and describe components of the Systems Approach

Figure 1.--Task Analysis of Techniques of Programmed Instruction

by the computer which pertain to types of programmed instruction frames.

B. Productive - On this type of task the student has to demonstrate competency by constructing a product which meets certain pre-set criteria. For example, the student is required to properly respond to a set of questions in order to demonstrate that he had developed a plausible formative evaluation plan.

C. Cognitive and Productive - On this type of task, the student has to complete both A and B above. For example, the student has to demonstrate competency in identifying various characteristics of entering behavior. In addition, he is required to properly respond to a set of questions in order to demonstrate that he has identified the major entering behavior characteristics for his proposed programmed instruction course.

The next step in the development of the course was to establish specific behavioral objectives for the tasks delineated in the content analysis. A minimum of one or a maximum of three behavioral objectives was written for each task. For example, Task 7, which deals with the topic of behavioral objectives, has one objective in which the student has to identify the major components of a behavioral objective and another in which the student has to demonstrate that he can identify objectives which are poorly written.

After the behavioral objectives were written for each task, fifteen criterion-referenced test items were constructed for each objective. These items were either true-false or multiple-choice. After revisions by three subject-matter experts, these items were coded in

Coursewriter II and implemented on the IBM 1500 Computer System.

In addition, during this period, a course syllabus containing the list of tasks and associated behavioral objectives, sample test items and specific learning resource references, was developed. The syllabus also contained a description of the procedures which were to be followed by the students in the course.

Implementation of the Graduate Course. At the initial meeting of the course, the students were given the syllabus. After a general explanation of the course, the students were given a detailed description of the procedures which would be used under CMI. They were told that, after studying for a task, they should schedule a terminal at the CAI Center in order to take a quiz on the specific behavioral objectives for that task. Each of the quizzes consisted of five items randomly selected by the computer from the pool of fifteen for each of the objectives in the task. On the productive tasks, the student was required to respond to a series of questions concerning his product. Depending upon the performance of the student on the test, he was either required to restudy the instructional materials and be retested with another random set of test items or to choose the next task he wanted to work on. Figure 2 is a flow chart which shows the sequence of steps for the student at the terminal required for each task.

There were no more classes until the final regularly scheduled meeting of the course. The students proceeded through the course in an individualized, self-paced manner; they simply reported to the CAI Center when they were ready to complete a task(s).

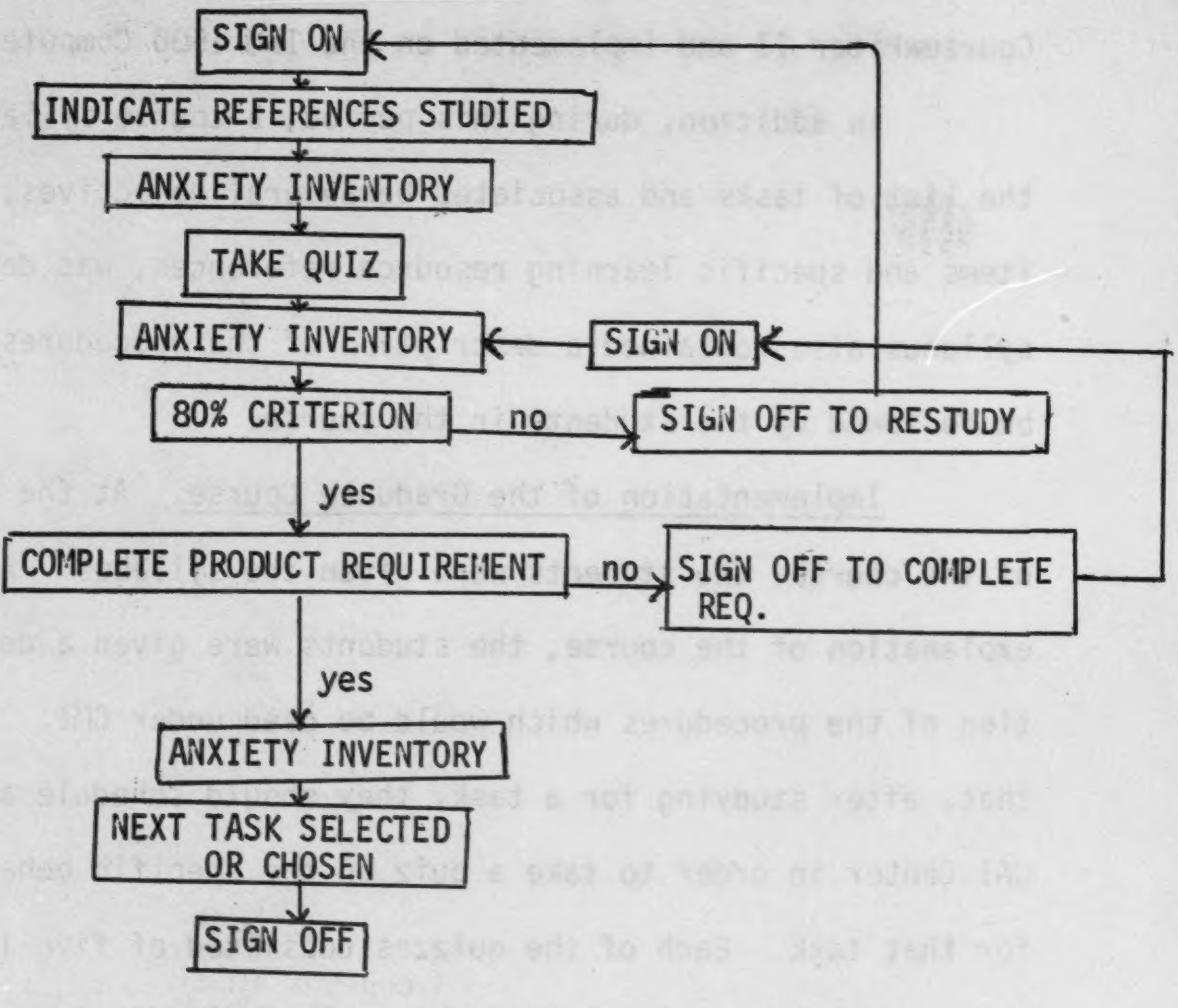
SIGN ON
INDICATE REFERENCES STUDIED
ANXIETY INVENTORY
TAKE QUIZ
ANXIETY INVENTORY
SIGN ON
80% CRITERION
no
SIGN OFF TO RESTUDY
yes
COMPLETE PRODUCT REQUIREMENT
no
SIGN OFF TO COMPLETE REQ.
yes
ANXIETY INVENTORY
NEXT TASK SELECTED OR CHOSEN
SIGN OFF

Figure 2.--Logic flow for student proceeding through the CMI System.

Upon completion of the first thirteen tasks, the students were given a midterm examination on the behavioral objectives for those tasks. This examination could be taken at any time during the first seven weeks of the course.

The Documented Report on the students' development and evaluation of a PI sequence could be handed in at any time up to and including the final class session when the entire class met as a group.

Evaluation Instruments

The instruments used to collect data for this investigation were a criterion-referenced pretest for the course, "Techniques of Programmed Instruction," a General Background Information Questionnaire, an Attitude Toward Learning Inventory, a State-Trait Anxiety Inventory, various subscales of the Omnibus Personality Inventory, a criterion-referenced posttest, and the students' documented reports on the development and evaluation of their PI texts. A description of these instruments, the rationale for their use, and their psychometric properties follows:

I. General Information Questionnaire--This questionnaire was developed by CAI personnel in order to identify the general background information and entry skills of the students. Since certain students may have had previously related courses in the Department of Educational Research or may have read certain of the primary references, it was important that this information be gathered in order to identify those students who might have had contacts with information that would allow them to have certain degrees of sophistication on specific tasks of the Techniques of Programmed Instruction course. (A copy of the questionnaire appears in Appendix E.)

II. Pretest on the Techniques of Programmed Instruction--This examination was a sixteen-item short answer criterion-referenced test. It was a product of the efforts of the professor and two graduate assistants who worked with the course. The validity of this instrument was determined by a consensus of the personnel involved with the course. This exam was administered in order to ascertain the entry behavior of the students who enrolled for the course. (See Appendix F.)

III. Attitude Toward Learning Inventory--This survey was developed by the Learning Service at the Michigan State University in order to assess a student's perception of himself as a learner. The survey uses Likert-type questions to assess student attitudes in five categories: (1) Mechanical Comfort-Discomfort; (2) Desire for Teacher Contact; (3) Initiative and Participation in the Learning Process; (4) Independence in Learning (Autonomy); and (5) Ease of Learning (See Appendix G for description). Davis, Denny, & Mazzocco (1967) report a reliability estimate of .937 using Hoyt's (1942) method of estimating reliability. This inventory was selected because its categories are measures of student attitudes which are relevant in an individualized learning environment.

IV. State-Trait Anxiety Inventory--The State-Trait Anxiety Inventory (STAI) developed by Spielberger et al. (1970) consists of separate self-report scales for measuring two distinctive types of anxiety: state anxiety (A-State) and trait anxiety (A-Trait). A-State is conceptualized as a transitory emotional state or condition of the student that varies in intensity and fluctuates over time. For this scale (Appendix H), people respond to statements indicating how they presently feel in a particular situation. A-Trait refers to a relatively stable individual difference in anxiety proneness, i.e., to differences in the disposition or tendency to respond with elevations in A-State in situations that are perceived as threatening. For this inventory (Appendix I), individuals respond to statements indicating how they generally feel. This inventory was chosen for use in order that a relationship between this important individual learner characteristic and success in the CMI course might be determined.

Internal consistency (alpha) reliabilities reported by Spielberger et al. (1970) indicate that both the A-State and A-Trait scales have substantial internal consistency coefficients which range from .86 to .92 for A-Trait and .83 to .92 for A-State. A-State and A-Trait alpha reliabilities of .80 and .85 for normal (nonstress) conditions and higher reliability (.90 to .95) for psychological stress conditions were also reported.

Test-retest reliabilities reported for the A-State Inventory are relatively low (.16 to .54). However, since this scale reflects conditions of the particular test situation and these conditions may vary greatly from situation to situation, these low coefficients are not surprising. Also, as would be expected, the test-retest reliabilities for the A-Trait scale are relatively high (.73 to .86). Spielberger et al., (1970) report relatively high correlation coefficients of validity with the Taylor Manifest Anxiety Scale (TMAS), the Institute for Personality and Ability Testing Anxiety Scale (IPAT), and the Zuckerman Affect Adjective Check List Anxiety Scale General Form (AACL-G) for both males and females. Using eighty Florida State University males, correlation coefficients of .76, .79, and .58 were respectively, for the IPAT, TMAS, and the AACL. Coefficients of .75, .80, and .52 were reported respectively on these same tests for 126 females. Correlations between earlier versions of the STAI A-Trait with the IPAT, AACL-G, and the TMAS were comparable (Spielberger, et al., 1970).

Since several studies have indicated that there is a relationship between anxiety and learning, and it was felt that this relationship might prove to be an important one in this investigation, the STAI scales were chosen. Also, since the paper and pencil version of the scales consists of only twenty items each and can be easily administered and completed in a few minutes, it was felt that it would serve as a quick, reliable and valid measure of both Trait and State anxiety.

V. Omnibus Personality Inventory (OPI)--The OPI Form F is an instrument designed to measure the differences among college students with regard to their attitudes, opinions, and feelings on a variety of dimensions. The complete inventory has 385 items and 14 scales. These scales measure, for example, thinking introversion, autonomy and complexity. (See Appendix J for a complete description of all the scales.) The publishers report a range of reliabilities for the fourteen subscales using KR_{21} calculations on a normative sample of 7,283 college students as being .67 to .89 with a mean of .81. Test-retest reliability estimates range from .84 to .95 with a mean of .89; however, these estimates were with a smaller number of college men and women (67 and 71). Validity coefficients of the OPI with the scales of the Allport-Vernon-Lindsey Study of Values, the California Psychological Inventory and the Minnesota Multiphasic Personality Inventory are also reported.

The OPI was specifically chosen for this study because of its non-clinical orientation and ease of administration. Also, the majority of the scales are extremely relevant and appropriate to an individualized learning situation such as the intended CMI course.

VI. Posttest on the Techniques of Programmed Instruction--This midterm examination was an alternate form of the pretest. The KR_{20} reliability estimate was .59. The validity of the instrument was determined by a consensus of the personnel involved with the course. This exam measured the student's cognitive gains from participating in the course. (See Appendix K.)

VII. Final Course Document Evaluation--This instrument was a check list used by course personnel to evaluate the students' documented reports on the design, implementation, and evaluation of their 30-60 minute programmed instruction texts. Scores could range from 0 to 75 points. An inter-rater reliability coefficient of .86 using the rating method developed by Guilford in 1954 (Dick & Hagerty, 1970) was found.

VIII. Student Attitude Toward CMI--This instrument was originally developed to measure student attitudes toward CAI (Brown, 1966). It was recently adapted to measure attitudes toward CMI. Brown reports a KR_{20} reliability estimate of .89. For the present group a reliability of .89 was obtained. (See Appendix L.)

IX. Five-item A-State Inventory--This five-item A-State scale consisted of items from the twenty item STAI A-State scale (Spielberger et al., (1970). In a series of studies using this scale, O'Neil (1970), Lawler, O'Neil, & Hansen, (1970), and Leherissey, O'Neil, & Hansen, (1970) report a range of alpha reliabilities from .81 to .89. (See Appendix M)

A listing of the specific independent measures appears in Appendix N.

Subjects

Fifty-nine graduate students who enrolled in the Fall quarter, 1969 for the course, "Techniques of Programmed Instruction" in the Department of Educational Research at Florida State University, served as subjects. The students included ten computer-assisted instruction trainees, eighteen music majors, ten educational research majors, ten education majors, eight science education majors, two psychology majors, and one biology major. Students were assigned to one of the experimental treatment groups using stratified sampling techniques; they were stratified on the basis of their major areas of graduate work.

Apparatus

The management of the instruction was conducted by the use of the IBM 1500 Instructional System (IBM, 1967). The IBM 1510 Instructional Display terminal equipped with light pen and typewriter keyboard served as the medium. The terminals were located in an air-conditioned, sound-deadened room. The CMI system presented all quiz materials and recorded all student responses.

Experimental Design

A factorial design was utilized in investigating sequence of instruction and evaluation of the student's progress in the development of a programmed instruction text. Sequencing conditions were either computer-assigned or student-selected, while evaluation was either by a computer/student interaction or by a discussion with the instructor. Figure 3 exemplifies the design.

		Evaluation (of Product by..)	
		Instructor	Computer
Sequence Of Tasks	Assigned	15 Ss	15 Ss
	Selected	14 Ss	15 Ss

Figure 3.--Experimental design with number of students.

Since the CMI course placed emphasis on the cognitive and productive aspects of the techniques of programmed instruction, both sequence of cognitive tasks and the type of evaluation of the student's product were investigated. Thus the four treatments were:

I. Sequence Assigned/Instructor Evaluated Products--This group of students proceeded through the twenty tasks in an assigned sequence. All students started with Task 1 and worked consecutively through Task 20. The students' products, e.g., his behavioral objectives, his test items, etc., were evaluated as they were completed by one of the course assistants.

II. Sequence Assigned/Computer Evaluated Products--This group of students proceeded through the twenty tasks in the assigned sequence (1 through 20 consecutively); however, the products which they produced were evaluated by the students themselves via an interactive dialogue with the computer. Upon completion of the interaction, the students passed or failed themselves on the particular product.

III. Self Sequence/Instructor Evaluated Products--This group of students had the freedom to proceed through the 20 tasks in a self-sequencing mode. The students' products were evaluated by one of the course assistants.

IV. Self Sequence/Computer Evaluated Products--These students also had complete autonomy in the sequencing of the 20 tasks. Their products were evaluated by a student/computer interaction, with the students passing or failing themselves.

Experimental Procedures

The treatment period for this investigation was ten weeks, the length of the fall academic quarter at Florida State University. Pre-treatment data were collected at the first meeting of the class. Additional data were collected during the quarter. End-of-course data were collected after the ten-week CMI course was completed.

At the initial class meeting, the procedures for the course were described. The students were told that they would be participating in a new course conducted by Computer-Managed Instruction. The specific instructional treatments were described. Also, the rationale for collecting specific personality, background, and attitude data was explained.

Following the explanation of the rationale and procedures for the course, the following battery of instruments was administered: (1) the general information questionnaire to determine specific student entry behaviors, (2) the attitude toward learning survey to determine the student's self-perception of himself as a learner, (3) the pretest and, (4) the A-Trait Scale of the STAI (Spielberger, et al., 1970). At the end of the class, each student was given a copy of the Omnibus Personality Inventory which he completed and returned before he encountered his first task at the CMI terminal.

There were no classes for the remainder of the course. The students proceeded through the course in an individualized manner reporting to the CAI Center when they were ready to complete a task(s). Figure 2 presents the procedure followed by the student when he came to the CAI Center. It is to be noted that the five-item A-State Inventory (O'Neil, Spielberger, & Hansen, 1969) was administered before and after each task quiz. This allowed the students to specify their feelings before and after each quiz.

Upon completion of the first thirteen tasks, the students were given an examination on the behavioral objectives for those tasks. This midterm examination could be taken at any time during the first seven weeks of the course. When a student was ready for the test, he was administered the following battery of instruments: (1) an STAI A-State scale given with standard instructions to determine his pretest A-state; (2) the posttest; (3) another A-State inventory given with instructions which asked him how he felt during the test; (4) the attitude toward learning inventory; and (5) the STAI A-Trait scale.

The Documented Report on the students' development and evaluation of a PI text could be turned in at any time up to and including the final class session when the entire class met as a group. During this final class meeting, the following battery of instruments was administered: (1) the Student Attitude Toward Computer-Managed Instruction Survey; (2) Information Questionnaire; (3) STAI A-Trait Scale;

(4) Attitude Toward Learning Inventory; (5) Student Assessment of the A-State Scales; (6) Ranking of difficulty of EDR 537 units; and (7) General Questionnaire Inventory.

CHAPTER IV

RESULTS

The presentation of the results for this investigation is organized into four major sections. In the first section, comparisons of the four instructional treatments are presented. Second, the results of the learner characteristics/performance data are reported. Third, the relationship of A-State and performance on the tasks is described. Finally, a cost analysis of the operational characteristics of the course is presented.

Comparison of Instructional Treatments

Comparisons among the instructional treatment groups were made in four separate two-way analyses of (ANOVA) variance in which the following dependent variables were used: (1) midterm examination, (2) the final score on a documented PI text, (3) total time spent at the terminal, and (4) the time (in days) to complete Tasks 1-13. For each of these analysis, sequence (assigned vs selected) and method of evaluation (computer vs instructor) were the independent variables.

The mean and standard deviations for the four instructional treatments for the midterm examination scores are presented in Table 1. It may be noted that there is very little difference in mean performance between the four treatment groups. The ANOVA for these data is presented in Table 2. The absence of any statistically significant effects involving sequence or evaluation indicated that score on the midterm examination were not influenced by either sequencing or evaluation.

TABLE 1.--Means and standard deviations of four instructional treatments for midterm examination scores

Instructional Treatment	Mean	Standard Deviation
Self Sequenced Computer Evaluated	95.80	4.46
Self Sequenced Instructor Evaluated	95.27	5.53
Sequenced Assigned Computer Evaluated	92.14	9.15
Sequenced Assigned Instructor Evaluated	94.73	4.33

TABLE 2.--Analysis of variance: four instructional treatments on midterm examination scores

SOURCE	df	MS	f
Sequence	1	64.69	1.73
Evaluation	1	15.59	<1
Interaction	1	35.95	<1
Error	55	37.42	
Total	58		

In Table 3, the means and standard deviations of the four instructional treatment groups for the final product score are presented.

TABLE 3.--Means and standard deviations of four instructional treatments for final product score

Instructional Treatment	Mean	Standard Deviation
Self Sequenced Computer Evaluated	50.53	9.75
Self Sequenced Instructor Evaluated	51.53	7.00
Sequence Assigned Computer Evaluated	46.06	9.93
Sequence Assigned Instructor Evaluated	48.93	8.04

Although the self-sequenced groups did better on the final product than the sequence assigned groups, neither these differences nor any other were statistically significant as may be seen in Table 4.

TABLE 4.--Analysis of variance: four instructional treatments on final product score

SOURCE	df	MS	f
Sequence	1	183.73	2.42 N.S.
Evaluation	1	54.94	<1
Interaction	1	12.77	<1
Error	55	75.77	
Total	58		

With regard to total time spent at the terminal, it may be noted in Table 5 that the Sequence Selected/Instructor Evaluated group spent the least amount of time, whereas the Sequence Assigned/Computer Evaluated group spent the most time. However, when these data were statistically analyzed, these differences were not statistically significant as may be seen in Table 6.

TABLE 5.--Means and standard deviations of four instructional treatments for total time spent at the terminal (system time)

Instructional Treatment	Mean	Standard Deviation
Sequence Selected Computer Evaluated	260.2	54.11
Sequence Selected Instructor Evaluated	251.53	44.32
Sequence Assigned Computer Evaluated	284.28	46.96
Sequence Assigned Instructor Evaluated	262.53	39.79

TABLE 6.--Analysis of variance of four instructional treatments on total terminal time (system time)

Source	df	MS	f
Evaluation	1	4518.06	2.082 N.S.
Sequence	1	3424.02	1.578 N.S.
Interaction	1	624.45	<1
Error	55	2169.58	
Total	58		

These means and standard deviations for total time spent on Tasks 1-13 (midterm examination material) are presented in Table 7. When these differences between these groups were statistically analyzed as shown in Table 8, no significant effects due to either Evaluation or Sequence were noted. Thus time to complete Tasks 1-13 was independent of type of evaluation or sequence.

TABLE 7.--Means and standard deviations of four instructional treatments for time (days) to complete tasks 1-13

Instructional Treatment	Mean	Standard Deviation
Self Sequence Computer Evaluated	42.80	4.77
Self Sequence Instructor Evaluated	41.87	5.71
Sequence Assigned Computer Evaluated	43.20	2.62
Sequence Assigned Instructor Evaluated	42.64	4.85

TABLE 8.--Analysis of variance of four instructional treatments on time (days) to complete tasks 1-13

Source	df	MS	F
Evaluation	1	3.20	< 1
Sequence	1	8.40	< 1
Interaction	1	2.44	< 1
Error	55	21.37	
Total	58		

Relationship of Learner Characteristics to Performance

Five stepwise multiple regression analyses were conducted in order to isolate attitude, personality, and background information which may have contributed to the variance of each of the dependent measures. The first three analyses regressed on the following dependent variables: (1) midterm score; (2) course completion time; and (3) final product score. The fourth and fifth analyses were conducted on the Computer Evaluated and Instructor Evaluated groups, respectively, with the final product score as the dependent measure. These analyses are based on an N of fifty-two as seven students were dropped due to incomplete data on the learner characteristics measures.

The results of the five stepwise multiple analyses which identify the learner characteristics which were related to course success are presented in Tables 9, 10, 11, 12, and 13. These tables also indicate the

Pearson Product correlational relationship with the dependent variable. For the first dependent measure, midterm score, a multiple R^2 of .39 (df=44; $p < .05$) was obtained after extracting the first eight variables (see Table 9). Six of the variables from the Omnibus Personality Inventory accounted for the initial thirty-four percent of the variance while the pretest score and autonomy score from the Attitude Toward Learning Inventory accounted for the remaining five percent. Table 10 shows that for the dependent measure, time to complete the Tasks 1-13, the extraction of the first ten variables yields a multiple R^2 of .36 (df=42; $p < .05$). The results of the third multiple regression analysis which regressed the final product score for the total group yielded a nonsignificant multiple R^2 of .20 after extracting the first seven variables (see Table 11).

TABLE 9.--Stepwise multiple regression variance estimates: Mid-term exam score for total group

	Pearson r	R^2
Omnibus Personality Inventory (OPI) Masculinity-Femininity	.23	.05
OPI Thinking Introversion	.18	.13
OPI Complexity	-.15	.19
OPI Personal Integration	.02	.23
OPI Anxiety Level	.16	.31
OPI Response Bias	.23	.34
Attitude Toward Learning Independence in Learning (Autonomy)	.17	.37
Pretest	.05	.39

TABLE 10.--Stepwise multiple regression variance estimates: Time (days) to complete tasks 1-13 for total group

	Pearson r	R^2
Omnibus Personality Inventory (OPI) Anxiety Level	-.29	.08
Attitude Toward Learning (ATL) East of Learning	.22	.13
ATL Desire for Teacher Contact	-.14	.17
OPI Complexity	-.15	.19
OPI Autonomy	.04	.24
OPI Religious Orientation	.03	.26
OPI Response Bias	-.20	.28
OPI Impulse Expression	.07	.31
Attitude Toward CMI (Brown)	-.17	.33
OPI Masculinity Femininity	-.16	.36

TABLE 11.--Stepwise multiple regression variance estimates: Final product score for total group

	Pearson r	R^2
Pretest	.20	.04
Trait Anxiety (STAI)	-.10	.09
Attitude Toward Learning Initiation and Participation in the Learning Process	.11	.11
Omnibus Personality Inventory (OPI) Personal Integration	.04	.14
Attitude Toward CMI (Brown)	.16	.16
OPI Estheticism	-.10	.17
OPI Thinking Introversion	.10	.20

TABLE 12.--Stepwise multiple regression variance estimates: Final product score for instructor evaluated group

	Pearson r	R^2
Trait Anxiety (STAI)	-.51	.26
Pretest	.30	.41
Omnibus Personality Inventory (OPI) Estheticism	-.44	.61
Attitude Toward CMI (Brown)	.32	.68
OPI Complexity	.29	.74
OPI Masculinity-Femininity	.47	.79
Attitude Toward Learning (ATL) Independence in Learning	.05	.85

TABLE 13.--Stepwise multiple regression variance estimates: Final product score for computer evaluated group

	Pearson r	R^2
Omnibus Personality Inventory (OPI) Thinking Introversion	.24	.06
Attitude Toward Learning (ATL) Ease of Learning	.12	.10
OPI Practical Outlook	-.02	.14
OPI Personal Integration	-.11	.16
OPI Estheticism	.07	.22
Trait Anxiety (STAI)	-.03	.25
ATL Independence and Participation in the Learning Process	-.02	.29

The final two multiple regression analyses considered the method of evaluation of the students' products. Table 12 presents variance estimates for the final product score for the instructor-evaluated group. After extracting the first seven variables a multiple R^2 of .85 (df=45; $p < .05$) was yielded. It is to be noted that the first three variables account for sixty-two percent of the variance. The final stepwise regression analysis also regresson on the final product score for the Computer Evaluated group only. Table 13 shows that after extracting the first seven variables a multiple R^2 of .29 is yielded which was not significant. Discussion of these analyses is pursued in Chapter V.

At the final meeting of the class a questionnaire (see Appendix O) was administered in order to determine which students responded honestly to the five-item A-State inventory prior to and immediately following each of the quizzes for Tasks 1-13. Analysis of the questionnaire are presented in Table 14. Thirty-two students indicated that they had responded honestly to all of the scales while twenty-five indicated that they were honest some of the time and two indicated that they were never honest. It should be noted that analyses of the data of those who indicated that they had responded honestly some of the time revealed that the least most honest responding was conducted during the earlier tasks.

TABLE 14.--Analysis of anxiety questionnaire

Response Indicated	Number	Percent
Responded Honestly Always	32	54.2
Responded Honestly Sometimes	25	42.4
Responded HOnestly Never	2	3.4

On the basis of these data, thirty-nine separate correlation analyses were conducted in order to determine the relationship between A-State and first pass performance on the tasks. The reader must note that Pass was scored 2 and Fail was scored 1. Table 15 shows the relationship between: (1) pre-quiz anxiety state scores and quiz performance (pass or fail), (2) on-task* quiz anxiety state scores and quiz performance

POOR ORIGINAL COPY - BEST
AVAILABLE AT TIME FILMED

TABLE 15.--Correlation of A-State anxiety and quiz performance on tasks 1-13

	Pre-Quiz Anxiety State and Quiz Performance			Pre-Quiz Anxiety State and On-Task Quiz Anxiety State			On-Task Quiz Anxiety State and Quiz Performance		
TASK	Completely Honest	Sometimes Honest	Total	Completely Honest	Sometimes Honest	Total	Completely Honest	Sometimes Honest	Total
1	-.11	+.17	.00	+.70*	+.79*	+.73*	-.31	+.27	-.01
2	-.15	-.02	-.11	+.83*	+.68*	+.76*	-.32	+.38	-.34*
3	-.08	-.24	-.15	+.68*	+.53*	+.61*	-.12	-.74*	-.40*
4	-.19	-.29	-.23	+.54*	+.60*	+.53*	-.50*	-.60*	-.53*
5	+.10	-.32	-.09	+.53*	+.51*	+.68*	-.16	-.34	-.24
6	-.53*	+.01	-.32*	+.85*	+.75*	+.81*	-.52*	-.17	-.39*
7	-.36*	+.05	-.16	+.63*	+.39*	+.51*	-.60*	-.24	-.45*
8	-.09	-.15	-.15	+.73*	+.58*	+.67*	-.42*	-.56*	-.48*
9	-.39*	-.17	-.30*	+.81*	+.90*	+.85*	-.36*	-.31	-.34*
10	-.28	+.10	-.13	+.82*	+.73*	+.77*	-.36*	-.25	-.30*
11	-.20	+.33	+.02	+.80*	+.66*	+.75*	-.23	-.02	-.13
12	-.04	.00	.00	+.77*	+.81*	+.78*	-.19	-.00	-.13
13	-.17	-.16	-.17	+.59*	+.64*	+.61*	-.20	-.43	-.30

*p < .05

POOR ORIGINAL COPY - BEST
AVAILABLE AT TIME FILMED

2

and (3) pre-quiz anxiety state and post-quiz anxiety state scores, respectively, for those who indicated all honest responses, for those who indicated honest responses some of the time, and for the entire group. The relationships between pre-quiz state anxiety and on-task quiz state anxiety for the three groups are highly positive. The reader is to note that the analysis for the pre-quiz anxiety state with the quiz performance for the always honest, sometimes honest, and entire group all indicate little relationship between these two variables for the thirteen tasks. This is to be expected since the pre-quiz anxiety measure is a subjective indication of preparation for the quiz. In considering the relationships of on-task quiz anxiety state with quiz performance, it is important to note for the entire group, 9 of the 13 correlations were statistically significant, and all 13 correlations were negative. These results indicate that there is a relationship between poor performance on the quizzes and high on-task quiz anxiety states.

Cost of CMI Presentation

The results of the cost analysis of the presentation of the CMI course to 59 students is presented in Table 16. It is to be noted that the total cost of $1,764.47 is only the cost of the presentation of the course and does not include the developmental costs. A more detailed cost analysis of the design, implementation, and evaluation of the complete CMI course can be found in Hagerty (1970).

---

*Indicate a measure of how they felt during the quiz.

TABLE 16.--Cost analysis of course presentation

Graduate Assistant (One at $300 per month for 2 1/2 months)	$750.00
Terminal Cost (59 students at $3.33 per student hr. for 4.4 hrs.)	864.47
Publication Costs	150.00
Total	$1,764.47

CHAPTER V

DISCUSSION

Instructional Treatment Comparisons

In the present study, one of the major objectives was to attempt to determine which of four instructional treatments would insure the most efficient and effective course performance. In order to accomplish this, two factors must be considered and discussed: (1) performance within each of the treatments, and (2) cost of the CMI presentation.

Performance. Through both inferential and descriptive statistical methodology, it has been shown that for all of the dependent measures within this study, there were no statistically significant differences among the four treatment groups. That is, regardless of the instructional treatment the students were assigned to, their terminal performance was not different. Although the results of four analyses of variance were not statistically significant, there are certain interesting points which merit discussion.

As indicated by the group means for the four dependent measures - midterm score, final product score, system time, and time to complete Tasks 1-13 - (See Tables 2, 4, 6, and 8), the Sequence Selected groups outperformed the Sequence Assigned groups. Since there were no significant differences on the pretest between groups (see Appendix M), these data seem to indicate that the students who were given the individual opportunity and freedom to sequence and control their own instructional materials, showed a trend toward superior performance. They had higher mean scores on the midterm and final product and lower mean scores on system time and time to complete the cognitive portion of the course. These results appear to coincide with the basic philosophy of individualized instruction in that students will perform better when they are allowed freedom within the educational system. In contrast, when students were required to perform in a structured situation (Sequence Assigned) which more closely resembles traditional structured instruction, performance was lower. These results suggest that even though the Sequence Assigned groups participated in the "individualized" course, the structuring of their instructional sequence tended to inhibit their performance.

In addition, it is interesting to note that the Sequence Assigned-Computer Evaluated group demonstrated the lowest performance on all of the dependent measures. This particular treatment group was the most structured of the four. These results can be interpreted as indicating that, if possible, the amount of structure within an individualized course should be limited. Compelling a student to proceed through a highly structured instructional sequence appears to inhibit performance.

Cost. In considering only the actual presentation costs of the course, it is interesting to note the components required to determine individual student costs. The total cost of $1,764.47 can be divided by the number of students (59) to yield a cost of $29.90 for each student. This figure, in turn, can be divided by the actual number of teacher-student contact hours in the conventionally taught course. Since this course was a five credit course which met for ten weeks, the number of contact hours would be 50. Therefore, the actual cost of the course per student hour was $ .59.

However, since there were no differences between the Computer Evaluated and the Instructor Evaluated groups, it stands to reason that the instructor or student assistant, in this case, could be removed from the system. If this were done, the adjusted total cost for the presentation of the course would be $1,014.47. After appropriate analysis of this figure, the total cost per student hour would be $ .34. Thus, by eliminating the Teacher Evaluation, the cost per student hour could be reduced by $ .25 per student hour.

In conclusion, it appears that through the combination of the performance and cost data, the Sequence Selected-Computer Evaluated group would tend to be the most effective and efficient instructional treatment. This treatment would allow the student complete autonomy to select his own sequence while at the same time eliminate the cost of the Student Assistant or Professor.

Relationship of Learner Characteristics to Performance

The multiple regression analyses conducted in order to determine the relationship between personality, attitude, and background measures and performance yielded results which suggest that there are learner characteristics which are related to success in a CMI course. The results of the five separate analyses will be discussed.

The first analysis regressed the specific learner characteristics on the dependent measure, midterm or cognitive examination. The results of this analysis showed that a major portion of the variance is being accounted for by six personality characteristics as measured by the

Omnibus Personality Inventory, an attitude measure and the pretest score. In considering these variables it can be summarized that the students who performed best on the midterm examination could be characterized by a liking for reflective thought and academic activities, and admit to few attitudes and behaviors that characterize anxious, disturbed, or socially alienated persons. The positive correlation with autonomy indicates that better performers desire independence in the learning situation. Thus, in conclusion, it can be stated that the students who demonstrated superior performance are those who could perceive the CMI individualized learning environment as increased freedom with no non-threatening features.

The second analysis which regressed on the dependent measure, time to complete Tasks 1-13, yielded a Multiple R^2 of .36 for the first ten variables. Seven of the variables are from the Omnibus Personality Inventory, two from the Attitude Toward Learning Inventory, and one was an overall measure of attitude toward CMI. It is to be noted that the high scores on this measure were for those students who took the greater number of days to complete the first thirteen tasks. The results indicate that those who took longest to complete Tasks 1-13 could be characterized as those who have low feelings of anxiety, tend to get along well by themselves, while at the same time they try to make a good impression. In other words, the students who tended to take a greater amount of time to complete the cognitive portion of the course could be characterized as persons who appeared to be comfortable and non-threatened in the learning situation.

The final three regression analyses regressed on the various personality, attitude, and background characteristics or the dependent measure, final product score. One analysis was conducted in order to identify variables related to success for the entire CMI sample. Then two additional analyses were conducted for Instructor Evaluated and Computer Evaluated groups in order to determine whether or not common predictor variables would be identified. The results of the two separate regression analyses suggest why the overall analysis of the final product was not significant.

In using the computer to evaluate student products, it appears that individual learner characteristics do not play a major role. In essence, the implications of this result are that with the use of the computer as an evaluator of student products, the role of individual differences in learner characteristic can be minimized. In contrast, individual differences in personality and prior knowledge were very important in the instructor evaluated group.

It is interesting to note that A-Trait predicted performance in the instructor evaluated group and not in the computer evaluated group. If one assumes that the treatment group which emphasized human interaction (instructor evaluated group) would result in a greater potential for threats to the individual student's self-esteem, then these results would be consistent with Trait-State Anxiety Theory. This theory would predict that in situations which involve a threat to self-esteem that the high trait anxious students would respond with greater increments in state anxiety than low trait anxious students. Thus, one would expect these differences to be most accentuated in the instructor evaluated group which involved threats to self-esteem. These A-State differences between high and low A-Trait students would lead to performance differences and thus high A-Trait students would exhibit poorer performance on the product than low A-Trait students.

In summary, it has been shown that the students who demonstrated superior performance on the dependent measures in the present study could be characterized as persons who were not anxious, liked to be active in the learning situation, and were generally enthusiastic about the CMI presentation. It is to be noted that final results presented on the Computer Evaluated group do offer interesting implications for minimizing individual differences in the learning situation when the computer is participating in the evaluation process. However, it should be noted by the reader that as a result of the type of learning tasks, i. e. criterion-referenced instruments, the possible amount of variance was reduced resulting in weaker learner characteristic - performance relationships.

Relationship of A-State to Task Performance

The important issue to be discussed in relation to A-State and quiz performance is that relationship between the on-task anxiety state and the performance on the quizzes. Considering the group of students who indicated that they had responded honestly to all of the A-State inventories, it has been shown that for eight of the thirteen tasks there were significant correlations. This indicates that a relationship exists between how well the student is performing on the task and his anxiety state. Behaviorally speaking, students who reported high on-task anxiety states demonstrated poorer performance. The implication of this finding is that the measure of on-task A-State anxiety could be used in predicting performance or assign remediation within CMI. Although the tasks in this investigation were relatively short and in-course adaptations would not be feasible, it is plausible that certain in-course adaptations could be made in larger courses (see Rivers, 1970). In other words, if A-State measures are periodically administered throughout a task, the information could be utilized in adapting the instruction. The adaptations could include remedial loops, enrichment materials, or possible anxiety reducing statements.

The relationship between pre-quiz anxiety state and on-task anxiety state for the three groups were highly significant for all thirteen tasks. This finding was to be expected in that both these measures were given within a relatively short period of time with only the task quiz intervening. It should be noted that the quizzes which were derived directly from the course behavioral objectives were not extremely difficult and appeared to be non-threatening. Therefore, due to the nature of the quizzes the changes in A-State were not significantly different.

In conclusion, it should be stated that the important finding of this aspect of the investigation is that of the relationship between on-task anxiety state and performance. With the use of data such as this, it will be possible to improve instruction by making in-course adaptations which will provide for more effective learning.

CHAPTER VI

SUMMARY

Within the context of a computer-managed instruction learning environment, there are a number of intriguing questions with regard to experimental treatments and various learner characteristics that can be investigated. Questions such as, "How does one assign students to alternate instructional treatments in a manner that the students' learning may be maximized?" or "Can specific learner characteristics which are related to course performance be identified and isolated?", merit answers. The primary objectives of this investigation were to determine if one of four instructional treatments in a CMI learning environment produced significantly better results in terms of student performance and whether specific learner characteristics which were related to course success could be identified in order that it might be possible to make predictive inferences about future students.

Therefore, this investigation critically examined various questions in regard to identifying both relevant learner characteristics and an optimum instructional treatment. An evaluation was conducted in order to ascertain under which of four experimental treatments students performed best. The treatments varied in terms of the sequence of tasks and the type of evaluation of a student's project, i.e.,the components of his PI text. The treatments were: (1) Computer Assigned Sequence-Instructor Evaluated Product, (2) Computer Assigned

Sequence-Computer Evaluated Product, (3) Student Selected Sequence-Instructor Evaluated Product, and (4) Student Selected Sequence-Computer Evaluated Product.

The materials used to collect data for this investigation were a criterion-referenced pretest for the course, "Techniques of Systematic Instruction," a General Background Information Questionnaire, an Attitude Toward Learning Survey, the State-Trait Anxiety Inventory, various scales from the Omnibus Personality Inventory, a criterion-referenced midterm examination, and an evaluation of the student's documented final report on the development of a PI text.

An IBM 1500 Instructional System was used. The IBM 1510 Instructional Display terminal equipped with light pen and typewriter keyboard served as the medium.

Fifty-nine graduate students who enrolled for the course, "Techniques of Programmed Instruction," in the Department of Educational Research at Florida State University, served as subjects. These subjects were assigned to one of four instructional treatments.

The treatment period for this investigation was ten weeks, the length of the fall academic quarter at Florida State. Pretest data was collected at the first meeting of the class. Additional data was gathered during the remainder of the quarter. Additional data was collected during the final meeting of the class.

At the first meeting of the class, the procedures for the course were described. The students were told that they would be participating in a new course and they would proceed through the course in various ways.

POOR ORIGINAL COPY - BEST
AVAILABLE AT TIME FILMED

The specific treatments were then described. The rationale for collecting specific personality, background, and attitude data was explained.

Upon completion of the explanation of the rationale and procedures for the course, the students were administered a battery of instruments. These included: (1) the general information questionnaire to determine specific student entry behaviors, (2) the attitude toward learning survey to determine the student's self-perception of himself as a learner, and (3) the pretest and, (4) the State-Trait Anxiety Inventory.

Upon completion of the first thirteen tasks, the students were given an examination on the behavioral objectives for those tasks. This examination could be taken at any time up to the end of the seventh week of the course.

The final product could be handed in at any time up to the final class session when the entire class met as a group. Another series of attitude and information questionnaires was administered at the last class session. (It should be noted that the class only met during the first and last scheduled meeting of the quarter.)

In order to determine the effects of the specific instructional treatments four separate analyses of variance were conducted. The dependent measures were the: (1) midterm examination, (2) final product score, (3) terminal or system time used, and (4) time (days) to complete the cognitive portion of the course (Tasks 1-13). No significant differences were found on any of the dependent measures. However, both Self Sequencing groups demonstrated superior performance on all measures except one. It was suggested by an additional cost analysis that the Sequence

Selected-Computer Evaluated Product treatment group would result in the most efficient and effective learning.

Generally, it has been demonstrated through the multiple regression analyses that the students who performed best on the dependent measures in this study could be characterized as persons who were not anxious, liked to be active in the learning situation, and were enthusiastic about the CMI presentation. An interesting finding can be implied from the findings of the Computer Evaluated group in that it appears that individual differences may be minimized.

In addition, it was found that a relationship exists between on-task A-State anxiety and performance on the tasks. The results indicate that the students who reported high on-task anxiety states demonstrated poorer performance. The implication of this finding is that the measure of on-task anxiety could be used in predicting performance and in-course adaptations could be made on the basis of these results.

In conclusion, this investigation suggested possible answers to a number of the important questions with regard to instructional treatments and individual learner characteristics in a Computer Managed Instruction course. It has been demonstrated that a Student Selected Sequence-Computer Evaluated Product instructional treatment would be most feasible. In addition, it has been shown that specific learner characteristics were related to course success and that a relationship between on-task anxiety and performance offers potential for in-course adaptations and remediation.

REFERENCES

Atkinson, R. C., & Wilson H. A. Computer-assisted instruction. In R. C. Atkinson & H. A. Wilson (Eds.), Computer-assisted instruction: A book of readings. New York: Academic Press, 1969.

Bolvin, J., & Lindvall, C. M. Individually prescribed instruction: One approach to the problem of individual differences. Printed brochure by The Learning Research and Development Center of The University of Pittsburgh, Pittsburgh, Pennsylvania, 1968.

Briggs, L. J. Learner variables and educational media. Review of Educational Research, 1968, XXXVIII(2).

Brudner, J. J. Computer-managed instruction..conclusion. Instructional Media, 1969, 1(2), 66-72.

Coulson, J. E. An instructional management system for public schools. System Development Corporation, Santa Monica, California, June, 1967, 16p. (TM-3298/002/00).

Davis, R. H., Denny, M. R., & Marzocco, F. N. Interaction of individual differences with methods of presenting programed instruction materials by teaching machine and computer. Final Report, December, 1967, Contract No. OEG-3-6-051119-1211, U. S. Office of Education.

Dick, W., Latta, R., & Rivers. L. Computer-assisted instruction: Part 3-sources of information. The BC Journal, 1970, 49(5).

Doty, B. A., & Doty, L. A. Programmed instruction effectiveness in relation to certain student characteristics. Journal of Educational Psychology, 1964, 55, 334-338.

Esbensen, T. Working with individualized instruction. Palo Alto, Calif.: Fearon Publishers, 1968.

Evans, J. L. Programing in mathematics and logic. In R. Glaser (Ed.), Teaching Machines and Programed Learning II. Washington, D.C.: National Education Association of the United States, 1965.

Flanagan, J. C. Project PLAN. In Technology and innovation in education. Prepared by the Aerospace Education Foundation, New York: Praeger Publishers, 1968.

Flanagan, J. C. Functional education for the 70's. Phi Delta Kappan, 1967, 49, 27-32.

Glaser, R. Adapting the elementary school curriculum to individual performance. Proceedings of the 1967 Invitational Conference on Testing Problems. Princeton, N. J.: Educational Testing Service, 1968, 3-36.

Grimes, J. W., & Allinsmith, W. Compulsivity, anxiety, and school achievement. Merrill-Palmer Quarterly, 1961, 7, 247-269.

Hagerty, N. K. Development and implementation of a computer managed institution system in graduate training. Unpublished doctoral dissertation, Florida State University, 1970.

Hansen, D. N. Learning outcomes of a computer-based multi-media introductory physics course. A paper presented at the American Research Association Annual Meeting, Chicago, February, 1968.

Hansen, D. N., Dick, W., & Lippert, H. T. CAI multi-media instruction in physics: A final evaluation on a threshold for research. A paper presented at the American Educational Research Association Annual Meeting, Los Angeles, February, 1969.

Hansen, D. N., Dick, W., & Lippert, H. T. Semiannual progress report: July 1, 1967 through December 31, 1967. Tallahassee, Florida: CAI Center, Institute of Human Learning, Florida State University.

Hickey, A. E. Computer-assisted instruction--A survey of the literature. 3rd edition. Newburyport, Mass: Entelek, Inc., 1968.

Kight, H. R., & Sassenrath, J. M. Relationship of achievement motivation and test anxiety to performance in programmed instruction. Journal of Educational Psychology, 1966, 14, 185-191.

Kooi, B. Y. Definition of course objectives and preparation of diagnostic tests for IMS. System Development Corporation, Santa Monica, California, July, 1968, 9p. (SP-3056/000/00).

Kooi, B. Y., & Coulson, J. E. Design of materials for an instructional management system. System Development Corporation, Santa Monica, California, July, 1967, 12p. (TM-3298/003/00).

Kropp, R. P., Nelson, W. H., & King, F. J. Identification and definition of subject matter content variables related to human aptitudes. Final Report, 1967, Contract No. OE-5-10-297, U. S. Office of Education.

Lawler, R. M., O'Neil, Jr., H. F., & Hansen, D. H. Anxiety and confidence in computer-assisted learning. Paper read at the American Educational Association Annual Meeting, Minneapolis, 1970.

Leherissey, B., Hansen, D. N., & O'Neil, Jr., H. F. Effects of memory support upon anxiety and performance in computer-assisted learning. Paper read at the American Educational Association Annual Meeting, Minneapolis, 1970.

Levin, G. R., & Baker, B. L. Item scrambling in a self-instructional program. Journal of Educational Psychology, 1963, 54, 138-143.

Levin, H., & Baldwin, A. L. Pride and shame in children. In M. R. Jones (Ed.), Nebraska Symposium on Motivation, Lincoln, University of Nebraska Press, 1959.

Levin, H., Baldwin, A. L., Gallwey, M., & Paivio, A. Audience stress, personality and speech. Journal of Abnormal and Social Psychology, 1960, 61, 469-473.

Lublin, S. C. Reinforcement schedules, scholastic aptitude, autonomy need, and achievement in a programed course. Journal of Educational Psychology, 1965, 56, 295-302.

Mager, R. F., & Clark, C. Explorations in student-controlled instruction. Psychological Resports, XIII, 1963, 71-76.

Mager, R. F., & McCann, J. Learning-controlled instruction. (Unpublished manuscript) Palo Alto, California: Varian Associates, 1961.

Majer, K. S. A study of computer-assisted multi-media instruction augmented by recitation sessions. Technical Report No. 1, CAI Center, Institute of Human Learning, Florida State University, Tallahassee, Florida, June 1, 1969.

Markle, D. G. The development of the Bell system first aid and personal safety course: An exercise in the application of empirical methods to instructional system design. Palo Alto, California: American Institutes for Research, April, 1967.

Mitzel, H. E. The development and presentation of four college courses by computer teleprocessing. Final technical report of OE Contract No. 4-16-010. Pennsylvania State University, University Park, 1967.

Morgan, R. M. A review of developments in instructional technology. Florida Journal of Educational Research, 1969, 11(1), 93-112.

O'Dierno, E. N. Phase I report on a research study to develop a system for individualizing and optimizing learning through computer management of the educational process. New York Institute of Technology, 1968.

O'Neil, H. F., Spielberger, C. D., & Hansen, D. N. Effects of state anxiety and task difficulty on computer-assisted instruction. Journal of Educational Psychology, 1969, 60, 343-350.

Proctor, W. L. A comparison of the effects of computer-assisted instruction and lecture discussion methods of presentation in a general curriculum class. In D. Hansen, & W. Dick (Eds.), Semiannual progress report: July 1, 1967 through December 31, 1967. CAI Center, Institute of Human Learning. Florida State University, Tallahassee, Florida.

Rahmbow, H. F. The use of student performance data for improvement of individualized instructional materials. Paper read at the meeting of the American Psychological Association. Washington, D.C., 1969.

Ripple, R. E., Millman, J., & Glock, M. D. Learning characteristics and instructional mode. Journal of Educational Psychology, 1969, 60, 113-120.

Roe, A. Research in programmed learning. In J. E. Coulson (Ed.), Programmed learning and computer-based instruction. New York: John Wiley & Sons, 1962, 113-119.

Roe, K. V., H. W. Case, & Roe, A. Scrambled versus ordered sequence in autoinstructional programs. Journal of Educational Psychology, 1962, 53, 101-1-4.

Schurdak, J. J. An approach to the use of computers in the instructional process and an evaluation. American Educational Research Journal, 1967, 4, 59-73.

Schure, A. Aspects of education in the decade of the seventies. In J. B. Margolin, & M. R. Misch (Eds.), Education in the 70's. Educational Research Project. Program of Policy Studies in Science and Technology. George Washington University, Washington, D.C. Autumn, 1967, 126-141.

Schwartz, H. A., & Haskell, R. J. A study of computer-assisted instruction in industrial training. Journal of Applied Psychology, 1966, 50, 360-3.

Schwartz, H. A., & Long, H. S. A study of remote industrial training via computer-assisted instruction. Journal of Applied Psychology, 1967, 51, 11-16.

Silberman, Harry F. Design objectives of the instructional management system. System Development Corporation, Santa Monica, Calif., February 28, 1968, 6p. (SP-3038/001/00).

Silberman, H. F., Coulson, J. E., Melaragno, R. J., & Estavan, D. P. Fixed sequence vs. branching in a computer-based teaching machine. System Development Corporation, Santa Monica, Calif: 1960, (SP-195).

Snow, R. Aptitude-instructional treatment interactions: Selected findings and hypotheses. Paper presented at the annual meeting of American Educational Research Association, Los Angeles, February, 1969.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. The state-trait anxiety inventory (STAI): Preliminary test manual form X: Department of Psychology, Florida State University, 1968.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. The state-trait anxiety inventory (Test Manual). Palo Alto, Calif: Consulting Psychologists Press. In Press, 1970.

Stolurow, L. M., & Davis, D. J. Teaching machines and computer-based systems. In R. Glaser (Ed.), Teaching machines and programmed learning: Data and directions. Washington: National Educational Association, 1965, 162-212.

Suppes, P. On using computers to individualize instruction. In D. D. Bushnell, & D. W. Allen (Eds.), The computer in American education. New York: Wiley, 1967, 11-14.

Suppes, P. Progress report: Stanford program in computer-assisted instruction for the period April 1, 1968 to June 30, 1968. Institute for Mathematical Studies in the Social Sciences, Stanford University, Stanford, California, 1968.

Thomas, D. B. Effects of learner-control and prior knowledge on learning mathematical learning models under computer-assisted instruction. Unpublished doctoral dissertation; Florida State University, 1970.

Woodruff, A. B., Faltz, C., & Wagner, D. Effects of learner characteristics on programmed learning performance. Psychology in the Schools, 1966, 3, 72-77.

APPENDIX A

EXAMPLE OF A COGNITIVE AND PRODUCTIVE TASK
TASK 5

The following is an example of the quiz and product questions for Task 5. There are two cognitive behavioral objectives so the student receives 10 questions.

Cognitive Quiz

The behavior brought to the instructional situation by the student consists of the initial repertoire, aptitudes, and prior educational attainment.

a. true
b. false

Any given task may be specified as the entry behavior for;

a. only one other task
b. one or more tasks
c. a maximum of 10 tasks
d. cannot state

There are certain entry behaviors that can be assumed:

a. true
b. false

In a task analysis, the entry behaviors for specific tasks are referred to as:

a. subordinate tasks
b. superordinate
c. terminal tasks
d. none of the above

Entry behavior is where:

a. instruction concludes
b. instruction acts as a mediator
c. instruction must begin
d. none of the above

One of the basic entry behaviors for a person who is learning to bake a cake is that he know how to:

a. measure	c. bake bread
b. cook meat	d. all of the above

The entry behavior required for a course in writing programmed instruction would be knowledge of:

a. learning hierarchies	c. evaluation methodology
b. the Systems Approach	d. possibly c, but not a or b

The entry behavior required for EDR 537 was that the student:

a. be familiar with the systems approach
b. be a graduate student in good academic standing
c. have completed EDR 536
d. all of the above

One of the required entry behaviors for admission to graduate school is a minimum score on the GRE.

a. true
b. false

The entry behavior required for a course in U.S. history, covering the years 1900 to 1940, would be:

a. History of the U.S. from 1850 to 1900
b. History of the U.S. from 1950 to 1968
c. adequate reading ability
d. all of the above

Productive Evaluation

1. What prerequisite course(s) should the student have for your PI sequence?
2. What prerequisite skills will students need in order to take the sequence?
3. What are the characteristics of your target population? (age, sex, etc.)
4. Will your program be appropriate for teacher trainees?

POOR ORIGINAL COPY - BEST AVAILABLE AT TIME FILMED

5. Could it also be used as supplementary material for grade school students?

6. Do you need to collect individual difference data? (IQ, personality, etc.)

APPENDIX B

LIST OF BEHAVIORAL OBJECTIVES

For each cognitive objective the student had to achieve an 80% criterion by responding to multiple choice or true-false questions.

Task 1

The student will be able to identify (1) various uses of the Systems Approach, (2) reasons for using the Systems Approach, and (3) when the Systems Approach should be used.

The student will be able to identify the basic differences among the Systems Approach Models of Dick; Hansen; Glaser; and Taber, Glaser, and Schaefer.

The student will identify the elements in a Systems Approach, match those elements with definitions, and identify the three elements basic to all models.

Task 2

The student will be able to identify the basic criteria for choosing an area to be programmed.

Task 3

The student will be able to identify the various PI terms selected from the Glossary of Programmed Instruction Terminology.

The student will be able to identify those characteristics or descriptions of PI which distinguish it from non-PI material.

Task 4

The student will be able to identify the basic principles on the construction and use of a task analysis.

The student will be able to identify errors and inconsistencies in various score analyses of task analyses.

Task 5

The student will be able to identify the major characteristics and aspects of entering behavior.

Given specific tasks or topics, the student will be able to select the necessary entry behavior required.

Task 6

The student will be able to identify the definitions and characteristics of various types of PI frames.
Given examples of PI frames, the student will be able to identify the type of frame or programmed variable used.

Task 7

The student will be able to identify the correct descriptions, the necessary conditions, and the specific characteristics of a behavioral objective.

Given sample objectives, thy student will be able to identify the components.

Task 8

The student will be able to identify the characteristics of Gagne's eight conditions of learning and Esbensen's four category classification scheme of behavioral objectives.

Given a series of examples, the student will be able to identify the type of learning involved, according to Gagne.

Task 9

The student is able to identify the definitions and characteristics of the various types of strategies available within programmed instruction.

Task 10

The student will be able to identify reasons for selecting various programming strategies.

Task 11

The student will be able to identify characteristics of various types of test items.

The student will be able to identify specific test items which measure specific behavioral objectives.

Task 12

The student will be able to identify the characteristics and features of summative and formative evaluations.

Task 13

The student will be able to identify characteristics of the use of the Systems Approach in developing materials for a medium other than PI.

APPENDIX C

OUTLINE OF COURSE SYLLABUS

1. Introduction
2. Availability of system time and course personnel office
3. Task Analysis of EDR 537
4. Sequence of tasks
5. System flow chart
6. Tasks 1 - 20; objectives and references
7. List of additional readings
8. Directions for a self-directed learning game
9. Project evaluation information
10. Bibliography

APPENDIX D

OUTLINE OF COURSE PROCEDURES

1. Explanation of major objectives of EDR 537
2. Description and rationale for new Computer-Managed Instruction Approach
3. Description of the development of the CMI course
4. Explanation of procedural activities of students
    - Scheduling system time
    - Use of library and materials
    - Appointment time of course personnel
5. Explanation of the rationale for collecting various attitude, personality and background information

APPENDIX E

EDR 537

TECHNIQUES OF PROGRAMMED INSTRUCTION

GENERAL INFORMATION QUESTIONNAIRE

NAME ____________________

SS NO. ____________________ AGE ____________________

MAJOR ____________________ MINOR ____________________

HIGHEST DEGREE ____________________

GRADUATE RECORD EXAM--MATH ____________ ENGLISH ____________

PRESENT GPA __________ TAKING COURSE FOR CREDIT ______ AUDIT ______

PHONE ____________________

Have you completed any of the following courses? (Check if yes)

_____ A. EDR 540--Briggs
_____ B. EDR 660 or 552-- Esbensen
_____ C. Other courses relating to programmed instruction (explain)

Have you read any of the following books? (Check if yes)

_____ A. Instructional Media--Briggs
_____ B. Sequencing of Instruction--Briggs
_____ C. The Psychology of Learning and Instruction--DeCecco
_____ D. An Introduction to Programmed Instruction--Deterline
_____ E. Working with Individualized Instruction--Esbensen
_____ F. Developing Programmed Instruction Materials--Espich and Williams
_____ G. Teaching Machines and Programmed Instruction--Fry
_____ H. The Conditions of Learning--Gagné
_____ I. Teaching Machines and Programmed Instruction II--Glaser
_____ J. A Guide to Programmed Instruction--Lysaught and Williams
_____ K. Preparing Instructional Objectives--Mager
_____ L. Good Frames and Bad--Markle
_____ M. Learning and Programmed Instruction--Taber, Glaser, and Schaefer
_____ N. Other Related Books (list below)

APPENDIX F

PRETEST

The following is a brief examination which will help us in determining your prior knowledge on some of the topics that will be taught in this course. Please work as quickly as possible answering as many questions as you can. Do not be discouraged if you cannot answer many of the questions since all of the needed information will be presented throughout the term.

1. Briefly explain what is meant by the use of the Systems Approach in the design of instructional materials.

2. List, in order, the seven steps in Dick's Systems Approach Model.

   1. ____________________ 5. ____________________
   2. ____________________ 6. ____________________
   3. ____________________ 7. ____________________
   4. ____________________

3. List the three elements basic to all Systems Approach models.

   1. ____________________
   2. ____________________
   3. ____________________

4. List at least three of the basic requirements necessary in choosing a subject matter area to be programmed.

   1. ____________________
   2. ____________________
   3. ____________________

5. Briefly define:

   Frame -

   Cue -

   Response Mode -

6. Briefly differentiate between programmed instruction material and non-programmed material.

7. Define task analysis in reference to instruction design.

8. List three characteristics of the learner that are considered as Entry Behaviors.

   1. ____________________

   2. ____________________

   3. ____________________

9. Briefly define:

   Discrimination Frame -

   Baboon Frame -

   Constructed Response Frame -

10. List the three necessary conditions of a well-written behavioral objective.

   1. ____________________

   2. ____________________

   3. ____________________

11. List Gagné's eight types of learning.

   1. ____________________ 5. ____________________

   2. ____________________ 6. ____________________

   3. ____________________ 7. ____________________

   4. ____________________ 8. ____________________

12. Briefly define:
    Intrinsic Programming -

    Extrinsic Programming -

    Adaptive Programming -

13. List at least two reasons for selecting a particular programming strategy.

14. List five characteristics of a well-written test item

    1. ____________________
    2. ____________________
    3. ____________________
    4. ____________________
    5. ____________________

15. Name two types of formative evaluation.

    1. ____________________
    2. ____________________

16. List the differences between using the Systems Approach in developing materials for programmed instruction materials and materials for any other medium.

APPENDIX G

QUESTIONS FROM THE ATTITUDES TOWARD LEARNING SURVEY

1. I prefer multiple-choice tests to essay exams.
2. I learn best by working closely and directly with a teacher.
3. I do not have very much mechanical aptitude.
4. I like to figure out how to do a thing by myself rather than be told.
5. I feel very uncomfortable when others know that I have made a mistake.
6. I do not have to have things repeated over and over again for me to learn them.
7. I have a good memory.
8. With very little effort I could have achieved better grades in high school.
9. I prefer to decide for myself how I will go about learning something new.
10. I like it when I find out immediately where I have made my mistakes.
11. I have never liked to participate directly in classroom projects.
12. By the time I have read a chapter through once, I have generally learned the important points and ideas on which I will later be tested.
13. Students are being treated more and more like IBM cards.
14. I get mad when teachers fail to hand back a test paper until several days after the test.
15. I prefer to plan my own study schedule rather than have someone else lay it all out for me.
16. I like to take detailed notes when I'm trying to learn something new.
17. I don't really require the "big picture" in order to learn the details.
18. I do best when someone else sets the learning pace and I can follow their lead.
19. Whenever I have to operate a machine, I become nervous.
20. I prefer to have people tell me what they want me to do then leave me alone to do it.
21. I don't like frequent exams in a course.
22. I learn slowly.
23. Machines can never change the fundamental nature of man.
24. I learn best by doing.
25. It is a teacher's responsibility to see to it that I learn the subject matter of a course.
26. I don't like to have my errors pointed out to me.
27. I like to know where I stand in a course at all times.
28. There are as many opportunities to form close personal friendships today as in the past.

APPENDIX H

STATE-TRAIT ANXIETY INVENTORY A-STATE SCALE

Self-Analysis Questionnaire

FORM X-1

DIRECTIONS; A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, that is, at this moment.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately so	Very much so
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I am regretful	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel rested	1	2	3	4
9. I feel anxious	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel "high strung"	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel over-excited and "rattled"	1	2	3	4
19. I feel joyful	1	2	3	4
20. I feel pleasant	1	2	3	4

Copyright c 1968 by CHARLES D. SPIELBERGER. Reproduction of this test or any portion thereof, by any process, without written consent prohibited.

APPENDIX I

STATE-TRAIT ANXIETY INVENTORY

A-TRAIT SCALE

FORM X-2

DIRECTIONS; A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you generally feel.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

		Almost never	Sometimes	Often	Almost always
1.	I feel pleasant	1	2	3	4
2.	I tire quickly	1	2	3	4
3.	I feel like crying	1	2	3	4
4.	I wish I could be as happy as others seem to be	1	2	3	4
5.	I am losing out on things because I can't make up my mind soon enough	1	2	3	4
6.	I feel rested	1	2	3	4
7.	I am "calm, cool, and collected"	1	2	3	4
8.	I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
9.	I worry too much over something that really doesn't matter	1	2	3	4
10.	I am happy	1	2	3	4
11.	I am inclined to take things hard	1	2	3	4
12.	I lack self-confidence	1	2	3	4
13.	I feel secure	1	2	3	4
14.	I try to avoid facing a crisis or difficulty	1	2	3	4
15.	I feel blue	1	2	3	4
16.	I am content	1	2	3	4
17.	Some unimportant thought runs through my mind and bothers me	1	2	3	4
18.	I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
19.	I am a steady person	1	2	3	4
20.	I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

APPENDIX J

OMMIBUS PERSONALITY INVENTORY--BRIEF SCALE DESCRIPTIONS

Thinking Introversion (TI): Persons scoring high on this measure are characterized by a liking for reflective thought and academic activities. They express interests in a broad range of ideas and in a variety of areas, such as literature, art and philosophy. Their thinking is less dominated by objective conditions and generally accepted ideas than that of thinking extroverts (low scorers). Most extroverts show a preference for overt action and tend to evaluate ideas on the basis of their practical, immediate application.

Theoretical Orientation (TO): This scale measures an interest in, or orientation to, a more restricted range of ideas than is true of TI. High scorers are interested in science and in some scientific activities, including a preference for using the scientific method in thinking. They are generally logical, analytical, and critical in their approach to problems.

Estheticism (ES): High scorers endorse statements indicating diverse interests in, as well as an appreciation of, artistic matters and activities. The focus of their interests tends to extend beyond painting, sculpture and music and includes interests in literature and dramatics.

Complexity (CO): This measure reflects an experimental orientation rather than a fixed way of viewing and organizing phenomena. High scorers are tolerant of ambiguities and uncertainties; they are generally fond of novel situations and ideas. Most high scorers very much prefer to deal with diversity and complexity, as opposed to simplicity and structure, and are disposed to seek out and enjoy unusual ambiguous events and experiences.

Autonomy (AU): The characteristic measured is composed of non-authoritarian attitudes and a need for independence. High scorers are sufficiently independent of authority, as traditionally imposed through social institutions, that they oppose infringements on the rights of individuals. They are tolerant of viewpoints other than their own, and they are nonjudgmental, realistic, and intellectually liberal.

Religious Orientation (RO): High scorers are skeptical of conventional religious beliefs and practices and tend to reject most of them, especially those that are orthodox or fundamentalistic in nature. Persons scoring near or above the mean are manifesting a liberal view of religious beliefs, and low scorers tend to be conservative in general and rejecting of other viewpoints. (The direction of scoring on this scale, with strong religious commitment indicated by low scores, was determined in part by the correlation between these items and the first four scales which together measure a general intellectual dispositon.)

Social Extroversion (SE): This measure reflects a preferred style of relating to people in a social context. High scorers, displaying a strong interest in being with people, seek social activities and gain satisfaction from them. The social introvert (low scorers) tends to withdraw from social contacts and responsibilities.

Impulse Expression (IE): This scale assesses a general readiness to express impulses and to seek gratification either in conscious thought or in overt action. High scorers have an active imagination, value sensual reactions, and their thinking and behavior has pervasive overtones of feelings and fantasies.

Personal Integration (PI): The high score admits to few attitudes and behaviors that characterize anxious, disturbed or socially alienated persons. Low scorers on the other hand, may intentionally avoid others and often express hostility and aggressions. They also indicate feelings of loneliness, rejection, and isolation.

Anxiety Level (AL): High scorers deny that they have feelings or symptoms of anxiety and do not admit to being nervous or worried. Low scorers are generally tense and highstrung and often experience some difficulty adjusting in their social environment.

Altruism (Am): The high scorer is an affiliative person and trusting in his relations with others. He exhibits concern for the feelings and welfare of people he meets. Low scorers tend to be much less concerred about the welfare of others and often view people from an impersonal, distant perspective.

Practical Outlook (PO): The high scorer on this measure is interested in practical, applied activities and tends to value material possessions and concrete accomplishments. The criterion most often used to evaluate ideas and things is one of immediate utility. Authoritarianism, conservatism and nonintellectual interests are very frequent personality components of persons scoring above the average.

Masculinity-Femininity(MF): This scale assesses some of the differences in attitudes and interests between college men and women. High scorers (masculine) deny interests in esthetic matters and they admit to few adjustment problems, feelings of anxiety, or personal inadequacies. They also tend to be somewhat less socially inclined than low scorers and more interested in scientific matters. Low scorers (feminine), besides stronger esthetic and social inclinations, also admit to greater sensitivity and emotionality.

Response Bias (RB): This measure represents an approach to assessing the students test-taking attitude. High scorers are responding to this measure in a manner similar to a group of students who were explicitly asked to make a good impression by their responses to these items. Low scorers, on the contrary, may be trying to make a bad impression.

POOR ORIGINAL COPY - BEST
AVAILABLE AT TIME

APPENDIX K

POSTTEST

7th Week Exam

This exam covers the thirteen cognitive tasks of EDR 537. Read and answer all questions carefully.

1. Briefly explain the major use of the Systems Approach in Education.

____

____

____

2. List, in order, the steps in Dick or Hansen's Systems Approach Model.

1. ____________________ 5. ____________________

2. ____________________ 6. ____________________

3. ____________________ 7. ____________________

4. ____________________

3. List the three elements basic to all Systems Approach Models.

1. ____________________

2. ____________________

3. ____________________

4. List five of the basic requirements necessary in choosing a subject matter area to be programmed.

1. ____________________ 4. ____________________

2. ____________________ 5. ____________________

3. ____________________

5. Briefly define:

    1. Step Size--

    2. Explicit Response--

    3. Feedback--

    4. Prompt--

6. Name three characteristics that differentiate programmed instruction material from non-programmed material.

    1. ______________________________

    2. ______________________________

    3. ______________________________

7. Define task analysis in reference to instructional design.

8. Briefly define what is meant by entry behavior (give particular examples).

9. Briefly define:

    1. Baboon Frame--

    2. Discrimination Frame--

    3. Confirmation Frame--

    4. Sub-terminal Frame--

10. A well-written behavioral objective contains:

    1. ______________________________

    2. ______________________________

    3. ______________________________

11. List and briefly define Gagne's eight types of learning.

1. ______________________________

____

2. ______________________________

____

3. ______________________________

____

4. ______________________________

____

5. ______________________________

____

6. ______________________________

____

7. ______________________________

____

8. ______________________________

____

12. Briefly define:

1. Adjunct programming--

2. Extrinsic programming--

3. Intrinsic programming--

4. Linear programming--

13. List at least two programming strategies and reasons for selecting each.

1. ______________________________

2. ______________________________

14. List and define at least four types at test items.

1. ______________________________

____

2. ______________________________

____

3. ______________________________

____

4. ______________________________

____

15. List five characteristics of a well-written test item.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

16. Briefly differentiate between formative and summative evaluation.

17. List the differences between using the Systems Approach in developing materials for programmed instruction and materials for any other medium.

****

APPENDIX L

STUDENT ATTITUDE TOWARD COMPUTER-MANAGED INSTRUCTION

Developed by Bobby R. Brown

This is not a test of information; therefore, there is no one "right" answer to a question. We are interested in your opinion on each of the statements below. Your opinions will be strictly confidential. Do not hesitate to put down exactly how you feel about each item. We are seeking information, not compliments; please be frank.

Name:______________________________ Date____________________

Name of Course:______________________ Student Number___________

CIRCLE THE RESPONSE THAT MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW:

1. While taking Computer-Managed Instruction I felt challenged to do my best work.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

2. The material presented to me by Computer-Managed Instruction caused me to feel that no one really cared whether I learned or not.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

3. The method by which I was told whether I had given a right or wrong answer became monotonous.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

4. I was concerned that I might not be understanding the material.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

5. I was not concerned when I missed a question because no one was watching me anyway.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

6. While taking Computer-Managed Instruction I felt isolated and alone.

All the time	Most of the time	Some of the time	Only occasionally	Never

7. While taking Computer-Managed Instruction I felt as if someone were engaged in conversation with me.

All the time	Most of the time	Some of the time	Only occasionally	Never

8. The responses to my answers seemed appropriate.

All the time	Most of the time	Some of the time	Only occasionally	Never

9. I felt uncertain as to my performance in the programmed course relative to the performance of others.

All the time	Most of the time	Some of the time	Only occasionally	Never

10. I found myself just trying to get through the material rather than trying to learn.

All the time	Most of the time	Some of the time	Only occasionally	Never

11. I knew whether my answers were correct or not before I was told.

Quite often	Often	Occasionally	Seldon	Very Seldom

12. I guessed at the answers to questions.

Quite often	Often	Occasionally	Seldom	Very Seldom

13. In a situation where I am trying to learn something, it is important to me to know where I stand relative to others.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

14. I was encouraged by the responses given to my answers of questions.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

POOR ORIGINAL COPY - BEST
AVAILABLE AT TIME FILMED

15. As a result of having studied some material by Computer-Managed Instruction, I am interested in trying to find out more about the subject matter.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

16. In view of the time allowed for learning, I felt too much material was presented.

All the time	Most of the time	Some of the time	Only occasionally	Never

17. I was more involved in running the machine than in understanding the material.

All the time	Most of the time	Some of the time	Only occasionally	Never

18. I felt I could work at my own pace with Computer-Managed Instruction.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

19. Computer-Managed Instruction makes the learning too mechanical.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

20. I felt as if I had a private tutor while on Computer-Managed Instruction.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

21. I was aware of efforts to suit the material specifically to me.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

22. I found it difficult to concentrate on the course material because of the hardware.

All the time	Most of the time	Some of the time	Only occasionally	Never

23. The Computer-Managed Instruction situation made me feel quite tense.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

24. Questions were asked which I felt were not relevant to the material presented.

All the time	Most of the time	Some of the time	Only occasionally	Never

25. Computer-Managed Instruction is an inefficient use of the student's time.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

26. I put answers in knowing they were wrong in order to get information from the machine.

Quite often	Often	Occasionally	Seldom	Very Seldom

27. Concerning the course material I took by Computer-Managed Instruction, my feeling toward the material before I came to Computer-Managed Instruction was:

Very favorable	Favorable	Indifferent	Unfavorable	Very unfavorable

28. Concerning the course material I took by Computer-Managed Instruction, my feeling toward the material after I came to Computer-Managed Instruction is:

Very favorable	Favorable	Indifferent	Unfavorable	Very unfavorable

29. I was given answers but still did not understand the questions.

Very often	Often	Occasionally	Seldom	Very seldom

30. While on Computer-Managed Instruction I encountered mechanical malfunctions.

Very often	Often	Occasionally	Seldom	Very Seldom

31. Computer- Managed Instruction made it possible for me to learn quickly.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree

32. I felt frustrated by the Computer-Managed Instruction situation.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

33. The responses to my answers seemed to take into account the difficulty of the question.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

34. I could have learned more if I hadn't felt pushed.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

35. The Computer-Managed Instruction approach is inflexible.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

36. Even otherwise interesting material would be boring when presented by Computer-Managed Instruction.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

37. In view of the effort I put into it, I was satisfied with what I learned while taking Computer-Managed Instruction.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

38. In view of the amount I learned, I would say Computer-Managed Instructon is superior to traditional instruction.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

39. With a course such as I took by Computer-Managed Instruction, I would prefer Computer-Managed Instruction to traditional instruction.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

40. I am not in favor of Computer-Managed Instruction because it is just another step toward de-personalized instruction.

Strongly Disagree   Disagree   Uncertain   Agree   Strongly Agree

APPENDIX M

SHORT FORM OF THE A-STATE SCALE STATE-TRAIT ANXIETY INVENTORY

SELF-ANALYSIS QUESTIONNAIRE

Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, that is, at this moment.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.	NOT AT ALL	SOME-WHAT	MODER-ATELY SO	VERY MUCH
1. I am tense	1	2	3	4
2. I feel at ease..........................	1	2	3	4
3. I am relaxed............................	1	2	3	4
4. I am jittery............................	1	2	3	4
5. I feel calm.............................	1	2	3	4

APPENDIX N

LIST OF INDEPENDENT VARIABLES

1. Omnibus Personality Inventory (OPI) Thinking Introversion
2. OPI Estheticism
3. OPI Complexity
4. OPI Autonomy
5. OPI Religious Orientation
6. OPI Impulse Expression
7. OPI Personal Integration
8. OPI Anxiety Level
9. OPI Practical Outlook
10. OPI Masculinity-Femininity
11. OPI Response Bias
12. OPI Theoretical Orientation
13. OPI Social Extroversion
14. OPI Altruism
15. Pretest
16. A-Trait Anxiety (Spielberger)
17. Attitude Toward Learning (ATL) Mechanical Comfort-Discomfort
18. ATL Desire for Teacher Contact
19. ATL Initiation and Participation in the Learning Process
20. ATL Independence in Learning
21. ATL Ease of Learning
22. Student Attitude Toward CMI
23. Number of Related Courses
24. Number of Related Resources Read

APPENDIX O

STUDENT ASSESSMENT OF ANXIETY SCALES

1. How often did you respond honestly to the anxiety scales before and after each task?

   ___ Always ___ Sometimes ___ Never

2. If you answered sometimes to the above question, at what time were you most honest?

   ___ Early in course ___ Middle of course ___ End of course

3. In regard to the number of scales, there were:

   ___ Too many ___ Too few ___ Neither too many or few

4. Do you feel that they were presented too frequently?

5. In the space below you may make any comments concerning the scales.

VITA

Paul D. Gallagher

Born: August 29, 1944

Social Security No.: 168-32-0753

Marital Status: Single

Address: 1-A Tully Building, Tallahassee, Florida 32306

Academic History

B.S., Psychology, Pennsylvania State University, 1966
M.S., Educational Research, Florida State University, 1968
Presently working toward Ph.D. in Educational Research at Florida State University (expected completion - June, 1970).

Professional Experience

Technical Instructional Specialist, USOE Title III #68-06399-0 Project, Wakulla County School System, Wakulla County, Florida. 1968 to Present: Responsible for consulting with the project director, CBI operational manager, and curriculum coordinators on the design and implementation of the various instruction materials and the CAI operation. Coordinated testing and evaluation activities associated with the project.

Graduate Fellow, Computer-Assisted Instruction (CAI) Center, Florida State University, Tallahassee, Florida, 1967-1968. Participant in year-long institute in obtaining an in-depth understanding of educational technology and Computer-Assisted Instruction. Experience with the IBM 1440 System and the IBM 1500 Instructional System. In-depth understanding of instructional design and strategies.

Psychologist, HRB-Singer, Inc., State College Pennsylvania, 1966-68. Development and evaluation of programmed instruction materials for initial and remedial training of photo interpretation skills via computer-assisted instruction techniques. Review and evaluation of alternative techniques for programmed instruction in IR imagery interpretation. Assisted in observing, recording and interviewing project attempting to determine the psychological factors related to the tolerance for confinement.

Staff assistant, Institute for Research, State College, Pennsylvania, 1964-1966. General experimental design, data reduction, and analysis for various research projects in the areas of driver behavior, psychopharmacology and decision-making.

Page two - Paul D. Gallagher - Vita

Authorship

An Experimental Study of Computer-Assisted Proficiency Maintenance and Improvement Techniques in Image Interpretation, with Robert T. Root and Robert Sadacca, Technical Report, Contract DA 49-092-ARO-142, U.S. Army Behavioral Science Research Laboratory, 1968.

A Rural County Computer-Related Instructional Technology Project, with Duncan Hansen and Ann Burks, Technical Report, CAI Center, Institute of Human Learning, Florida State University, Tallahassee, Florida, July, 1969.

Professional Memberships

American Education Research Association
American Psychological Association
National Society for Programmed Instruction

MILITARY

Chief of Naval Research
Code 458
Department of the Navy
Arlington, Va. 22217

Director
ONR Branch Office
495 Summer Street
Boston, Massachusetts 02210
Attention: Dr. Charles Starsh

Director
ONR Branch Office
219 South Dearborn Street
Chicago, Illinois 60604
Att: Dr. Morton Bartin

Director
ONR Branch Office
1030 East Green Street
Pasadena, California 91101
Att: Dr. Eugene Gloye

Director, Naval Research Laboratory
Washington, D.C. 20390
ATTN: Library, Code 2029 (ONRL)

Office of Naval Research
Area Office
207 West Summer Street
New York, New York 10011

Office of Naval Research
Area Office
1076 Mission Street
San Francisco, California 94103

Technical Library
U.S. Naval Weapons Laboratory
Dahlgren, Virginia 22448

Research Director, Code 06
Research and Evaluation Department
U.S. Naval Examining Center
Building 2711 - Green Bay Area
Great Lakes, Illinois 60088
ATTN: C.S. Winiewicz

Director
Naval Research Laboratory
Washington, D.C. 20390
Attn: Technical Information Division

Defense Documentation Center
Cameron Station, Building 5
5010 Duke Street
Alexandria, Virginia 22314

Commanding Officer
Service School Command
U.S. Naval Training Center
San Diego, California 92133

Commanding Officer
Naval Personnel and Training
Research Laboratory
San Diego, California 92152

Commanding Officer
Naval Medical Neuropsychiatric
Research Unit
San Diego, California 92152

Commanding Officer
Naval Air Technical Training Center
Jacksonville, Florida 32213

Dr. James J. Regan, Code 55
Naval Training Device Center
Orlando, Florida 32813

Chief
Naval Air Technical Training
Naval Air Station
Memphis, Tennessee 38115

Director
Education and Training Sciences Dept.
Naval Medical Research Institute
National Naval Medical Center
Building 142
Bethesda, Maryland 20014

Chairman
Behavioral Science Department
Naval Command and Management Division
U.S. Naval Academy
Luce Hall
Annapolis, Maryland 21402

Dr. A. L. Slafkosky
Scientific Advisor (Code AX)
Commandant of the Marine Corps
Washington, D.C. 20380

Behavioral Sciences Department
Naval Medical Research Institute
National Naval Medical Center
Bethesda, Maryland 20014

Director
Aerospace Crew Equipment Department
Naval Air Development Center
Johnsville
Warminster, Pennsylvania 18974

Chief of Naval Material (MAT 031M)
Room 1323, Main Navy Building
Washington, D.C. 20360

Library, Code 0212
Naval Postgraduate School
Monterey, California 93940

Technical Reference Library
Naval Medical Research Institute
National Naval Medical Center
Bethesda, Maryland 20014

Technical Library (Pers-lib)
Bureau of Naval Personnel
Department of the Navy
Washington, D.C. 20370

Personnel Research and Development
Laboratory
Washington Navy Yard, Building 200
Washington, D.C. 20390
ATTN: Library, Room 3307

Commander
Submarine Development Group TWO
Fleet Post Office
New York, New York 09501

Commander
Operational Test & Evaluation Force
U.S. Naval Base
Norfolk, Virginia 23511

Office of Civilian Manpower Management
Technical Training Branch (Code 024)
Department of the Navy
Washington, D.C. 20390

Chief of Naval Operations (Op-07TL)
Department of the Navy
Washington, D.C. 20350

Mr. George N. Graine
Naval Ship Systems Command (SHIPS 03H)
Department of the Navy
Washington, D.C. 20360

Chief
Bureau of Medicine and Surgery
Code 513
Washington, D.C. 20390

Technical Library
Naval Ordnance Station
Louisville, Kentucky 40214

Naval Undersea Research and
Development Center
3202 East Foothill Boulevard
Pasadena, California 91107
ATTN: Code 161

Commanding Officer
U.S. Naval Schools Command
Mare Island
Vallejo, California 94592

Commander, Naval Air Systems
Command
Navy Department, AIR-4132
Washington, D.C. 20360

Commandant of the Marine Corps
Headquarters, U.S. Marine Corps.
Code A01B
Washington, D.C. 20380

Technical Library
Naval Ship Systems Command
Main Navy Building, Room 1532
Washington, D.C. 20360

Mr. Philip Rochlin, Head
Technical Library Branch
Naval Ordnance Station
Indian Head, Maryland 20640

Director
Human Resources Research Organization
300 North Washington Street
Alexandria, Virginia 22314

Human Resources Research Organization
Division #1, Systems Operations
300 North Washington Street
Alexandria, Virginia 22314

Human Resources Research Organization
Division #3, Recruit Training
Post Office Box 5787
Presidio of Monterey, California 93940
ATTN: Library

Human Resources Research Organization
Division #4, Infantry
Post Office Box 2086
Fort Benning, Georgia 31905

Human Resources Research Organization
Division #5, Air Defense
Post Office Box 6021
Fort Bliss, Texas 79916

Human Resources Research Organization
Division #6, Aviation
Post Office Box 428
Fort Rucker, Alabama 36360

Scientific Advisory Team (Code 71)
Staff, COMASWFORLANT
Norfolk, Virginia 23511

Education & Training Developments Staff
Personnel Research & Development Lab.
Washington Navy Yard, Building 200
Washington, D.C. 20390

Dr. Don H. Coombs, Co-Director
ERIC Clearinghouse
Stanford University
Palo Alto, California 94305

ERIC Clearinghouse on
Educational Media and Technology
Stanford University
Stanford, California 94305

Director
Behavioral Sciences Laboratory
U.S. Army Research Institute of
Environmental Medicine
Natick, Massachusetts 01760

Chief, Training and Development Division
Office, Deputy Chief of Staff for
Personnel
Department of the Army
Washington, D.C. 20310

U.S. Army Behavior and Systems
Research Laboratory
Commonwealth Building, Room 239
Arlington, Virginia 22209

Division of Neuropsychiatry
Walter Reed Army Institute of Research
Walter Reed Army Medical Center
Washington, D.C. 20012

Behavioral Sciences Division
Office of Chief of Research and
Development
Department of the Army
Washington, D.C. 10310

Dr. George S. Harker, Director
Experimental Psychology Division
U.S. Army Medical Research Laboratory
Fort Knox, Kentucky 40121

Commandant
U.S. Army Adjutant General School
Fort Benjamin Harrison, Indiana 46216
ATTN: ATSAG-EA

Armed Forces Staff College
Norfolk, Virginia 23511
ATTN: Library

Headquarters, Electronic Systems Division
ATTN: Dr. Sylvia Mayer / ESMDA
L. G. Hanscom Field
Bedford, Massachusetts 01730

AFHRL (TR/Dr. G. A. Eckstrand)
Wright-Patterson Air Force Base
Ohio 45433

AFOSR(SRLB)
1400 Wilson Boulevard
Arlington, Virginia 22209

Headquarters, U.S. Air Force
AFPTRBD
Programs Resources and Technology Div.
Washington, D.C. 20330

Dr. Alvin E. Goins, Exec. Secretary
Personality and Cognition Research Review Committee
Behavioral Sciences Research Branch
National Institute of Mental Health
5454 Wisconsin Avenue, Room 10A02
Chevy Chase, Maryland 20015

Office of Computer Information
Center for Computer Sciences and Technology
National Bureau of Standards
Washington, D.C. 20234

Executive Secretariat
Interagency Committee on Manpower
1111 Twentieth St., N.W., Room 251-A
Washington, D.C. 20036

Mr. Joseph J. Cowan, Chief
Psychological Research Branch (P-1)
U.S. Coast Guard Headquarters
400 Seventh Street, S.W.
Washington, D.C. 20226

Director of Research
U.S. Army Armor Human Research Unit
Fort Knox, Kentucky 40121
ATTN: Library

Director
Air University Library
Maxwell Air Force Base, Alabama 36112
ATTN: AUL-8110

Commandant
U.S. Air Force School of Aerospace Medicine
ATTN: Aeromedical Library (SMSL-4)
Brooks Air Force Base, Texas 78235

Personnel Research Division (AFHRL)
Lackland Air Force Base
San Antonio, Texas 78236

Headquarters, U.S. Air Force
Chief, Personnel Research and Analysis Division (AFPDPL)
Washington, D.C. 20330

AFHRL (HRTT/Dr. Ross L. Morgan)
Wright-Patterson Air Force Base
Ohio 45433

Dr. Donald L. Bitzer
Computer-Based Education Research Laboratory
University of Illinois
Urbana, Illinois 61801

Dr. C. Victor Bunderson
Computer Assisted Instruction Lab.
University of Texas
Austin, Texas 78712

Dr. Lee J. Cronbach
School of Education
Stanford University
Stanford, California 94305

Dr. F. J. DiVesta
Pennsylvania State University
320 Rackley Building
University Park, Pennsylvania 16802

Executive Officer
American Psychological Association
1200 Seventeenth Street, N.W.
Washington, D.C. 20036

Dr. Bernard M. Bass
University of Rochester
Management Research Center
Rochester, New York 14627

Mr. Edmund C. Berkeley
Computers and Automation
815 Washington Street
Newtonville, Massachusetts 02160

Mr. Wallace Feurzeig
Bolt, Beranek and Newman, Inc.
50 Moulton Street
Cambridge, Massachusetts 02138

S. Fisher, Research Associate
Computer Facility
Graduate Center
City University of New York
33 West 42nd Street
New York, New York 10036

Dr. John C. Flanagan
American Institutes for Research
Post Office Box 1113
Palo Alto, California 94302

Dr. Robert Glaser
Learning Research and Development Center
University of Pittsburgh
Pittsburgh, Pennsylvania 15213

Dr. Albert S. Glickman
American Institutes for Research
8555 Sixteenth Street
Silver Spring, Maryland 20910

Dr. Duncan N. Hansen
Center for Computer-Assisted Instr.
Florida State University
Tallahassee, Florida 32306

Dr. Robert Dubin
Graduate School of Administration
University of California
Irvine, California 02650

Dr. Philip H. DuBois
Department of Psychology
Washington University
Lindell & Skinker Boulevards
St. Louis, Missouri 63130

Dr. Marvin D. Dunnette
University of Minnesota
Department of Psychology
Elliot Hall
Minneapolis, Minnesota

Dr. Carl E. Helm
Department of Educational Psychology
Graduate Center
City University of New York
33 West 42nd Street
New York, New York 10036

Dr. Lloyd G. Humphreys
Department of Psychology
University of Illinois
Champaign, Illinois 61820

Dr. Robert R. Mackie
Human Factors Research, Inc.
Santa Barbara Research Park
6780 Cortona Drive
Goleta, California 93017

Dr. Richard Myrick, President
Performance Research, Inc.
919 Eighteenth St., N.W., Suite 425
Washington, D.C. 20036

Dr. Gabriel D. Ofiesh
Center for Educational Technology
Catholic University
4001 Harewood Road, N.E.
Washington, D.C. 20017

(E)

Dr. M. D. Havron
Human Sciences Research, Inc.
Westgate Industrial Park
7710 Old Springhouse Road
McLean, Virginia 22101

Dr. M.C. Shelesnyak
Interdisciplinary Communications Program
Smithsonian Institution
1025 Fifteenth St., N.W., Suite 700
Washington, D.C. 2005

Dr. Arthur I. Siegel
Applied Psychological Services
Science Center
404 East Lancaster Avenue
Wayne, Pennsylvania 19087

Dr. Paul Slovic
Oregon Research Institute
Post Office Box 3196
Eugene, Oregon 97403

Dr. Arthur W. Staats
Department of Psychology
University of Hawaii
Honolulu, Hawaii 96822

Dr. Benton J. Underwood
Department of Psychology
Northwestern University
Evanston, Illinois 60201

Dr. John Annett
Department of Psychology
Hull University
Hull
Yorkshire, England

ERIC Clearinghouse on Vocational
and Technical Education
The Ohio State University
1900 Kenny Road
Columbus, Ohio 43210

Dr. Ralph R. Canter
Military Manpower Research Coordinator
OASD (M&RA) MR&U
The Pentagon, Room 3D960
Washington, D.C. 20391

Chief, Naval Air Reserve Training
Naval Air Station
Box 1
Glenview, Illinois 60026

Mr. Luigi Petrullo
2431 North Edgewood Street
Arlington, Virginia 22207

Dr. Len Rosenbaum
Psychology Department
Montgomery College
Rockville, Maryland 20852

Dr. Joseph W. Rigney
Behavioral Technology Laboratories
University of Southern California
University Park
Los Angeles, California 90007

Educational Testing Service
Division of Psychological Studies
Rosedale Road
Princeton, New Jersey 08540

Dr. Harold Gulliksen
Department of Psychology
Princeton University
Princeton, New Jersey 08540

Dr. George E. Rowland
Rowland and Company, Inc.
Post Office Box 61
Haddonfield, New Jersey 08033

Dr. Mats Bjorkman
University of Umea
Department of Psychology
Umea 6, Sweden

LTCOL F. R. Ratliff
Office of the Assistant Secretary
of Defense (M&RU)
The Pentagon, Room 3D960
Washington, D.C. 20301

Deputy Director
Office of Civilian Manpower Management
Department of the Navy
Washington, D.C. 20390

Technical Library
Naval Training Device Center
Orlando, Florida 32813

(F)